R&S® M3TR Software Defined Radios
R&S® MR300xH/U
Service Manual
Intermediate Level

6124.8346.82 - 04

ROHDE&SCHWARZ

Radiocommunications Systems Division

Service Manual (I-Level)

©08/2010 Rohde & Schwarz GmbH & Co. KG

81671 Munich, Germany

Printed in Germany — Subject to change — Data without tolerances: order of magnitude only

The R&S logo, Rohde & Schwarz and R&S are registered trademarks of Rohde & Schwarz GmbH & Co. KG and their subsidiaries.

Trade names are trademarks of the owners.

Definitions

Check	In appropriate measurements by means of the specified test equipment, proper functioning of a unit or module is established.
Discolouration	Components such as connectors and printed circuit boards are examined if they have changed colour due to temperature effects and thus differ widely from their normal condition.
Disconnect	Pull off connector.
Examine	In case of trouble the unit / module or components such as e.g. connectors, are to be thoroughly checked for obvious mechanical damage.
Functional check	This means that components / modules / units are checked for proper functioning while installed.
Hazardous voltages	Voltages > 30 V_{rms} or 50 V_{pp} (AC) or 50 V (DC)
Make sure	Ascertain whether all mentioned requirements are met or all measures are taken to establish the required condition.
Open	Access is to be gained to the unit / module by observing the given instructions and safety precautions.
Perfect condition	This means that a component / module / unit has to be in a state which does not give cause to complaints.
Replacement	In case of trouble the replacement of modules is carried out in order to localize and eliminate the fault.
Replace	Components / modules / units which - due to damage and / or other defects - no longer meet the respective requirements or components / modules / units which during troubleshooting were identified as the cause of fault, are to be replaced.
Visual examination	This is a visual inspection of the outer appearance and completeness of a component / module / unit without manual interference by the examiner. This does not include the necessary preparations and finishing work such as opening and closing of covers or similar.

Notices

The three different notices used in this documentation have the following meaning:

⚠ WARNING

This heading is used to indicate that inaccurate observance or nonobservance of instructions or methods can cause injury or even fatal accidents or during an operation described hazardous material can be set free in the unit or system.

⚠ CAUTION

This heading is used to indicate that inaccurate observance or nonobservance of instructions or methods can cause damage to the unit.

NOTICE

This heading is used to draw the reader's attention to a particular fact.

User Informations

NOTICE

The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

Purpose of the Manual

This Manual provides all information the service staff need to maintain intermediate level of repairs.

It contains the troubleshooting instructions down to module level. In case of trouble this allows straightforward error localization as well as easy replacement of the module.

Measuring Units

In this Manual the basic SI measuring units and units coherently derived from them are used by preference. In exceptional cases units legally derived from the SI units acc. to DIN1301 may also be used.

Abbreviations

ACR	adjacent-channel rejection
AF	audio frequency
ALC	automatic level control
ALE3G	Automatic Link Establishment 3rd Generation
ANT	antenna
ATU	antenna tuning unit
BP	battery pack
CCITT	Comité Consultatif International Télégraphique et Téléphonique
CM	continuous monitoring
CNR	combat net radio
CW	continuous wave
DSP	digital signal processing/processor
DSPx	DSP extender board
EMC	electromagnetic compatibility
EMF	
EPM	electronic protection measures
F3E	frequency modulation (voice communication)
FE	frontend
FW	firmware
GPS	global positioning system
HF	high frequency
HPP	protection processor
HW	hardware
I/Q	inphase/quadrature (modulation)
IBIT	initiated built-in test

IF	intermediate frequency
IM	intermodulation
IN	input
J3E	amplitude modulation (one sideband, no carrier)
LC	liquid crystal
LED	light-emitting diode
Li-ion	lithium ion (battery type)
$LiSO_2$	lithium sulphur dioxide (battery type)
M3TR	multiband, multimode, multirole tactical radio
MGC	manual gain control
MMI	man-machine interface
OUT	output
PA	power amplifier
PBIT	power-on built-in test
PDM	product data management
PC	personal computer
PEP	peak envelope power
POP	product online profile
PS	power supply
PTT	push to talk
R&S	registered trademark of Rohde & Schwarz GmbH & Co. KG
RC	radio controller
RCB	radio control bus
RF	radio frequency
RFU	radio frequency unit
RMS	root mean square
RS 232	serial interface standard
RS 422	interface standard
RS 485	serial interface standard
RSSI	receive signal strength indicator

Rx	receive
S/N	signal-to-noise ratio
SECOM-H	special EPM procedure for HF
SECOM-V	special EPM procedure for VHF
SECOS	secure EPM communication system
SINAD	signal-to-noise ratio and distortion
SSB	single sideband modulation
SQL	squelch
STANAG	standard NATO agreement
SW	software
SYN	synthesizer
THD	total harmonic distorsion
Tx	transmit
UHF	ultra high frequency
USB	universal serial bus
VCO	voltage controlled oscillator
VHF	very high frequency
VSWR	voltage standing wave ratio

Table of Contents

1 General Data 1.1

2 Construction 2.1

3 Function 3.1

3.1 Rx Signal Path 3.2

3.2 Tx Signal Path 3.3

3.3 Settings and Cabling 3.4

3.3.1 General 3.4

3.3.2 MR 300xH/U Cabling 3.4

4 Maintenance 4.1

4.1 Test Equipment, Tools and Software 4.1

4.2 Test Setup 4.2

4.3 Visual Examinations 4.6

4.4 Leak Test 4.8

4.5 General Fault Isolation Procedures 4.10

4.5.1 Power Consumption 4.12

4.5.2 Man Machine Interface Function 4.16

4.5.3 Audio Connector X4 and/or Data Connector X5 ..... 4.17

4.5.4 HF-V/UHF Antenna Switch 4.19

4.5.5 GPS Connector X2 ..... 4.20

4.5.6 RF Power of Transmitter in Fix Frequency Mode 4.21

4.5.7 Power at Rear Connector X6 ..... 4.25

4.5.8 Frequency Accuracy of Transmitter in Fix Frequency Mode 4.26

4.5.9 Harmonic Emission of Transmitter in Fix Frequency Mode 4.27

4.5.10 Transmitter Noise in Fix Frequency Mode 4.28

4.5.11 Two-tone Intermodulation of Transmitter in Fix Frequency Mode 4.30

4.5.12 VSWR Reduction of Transmitter in Fix Frequency Mode 4.32

4.5.13 Sensitivity of Receiver in Fix Frequency Mode 4.34

4.5.14 Desensitization of Receiver in Fix Frequency Mode 4.40

4.5.15 Frequency Response of Receiver in Fix Frequency Mode 4.41

4.5.16 IF Recjection of Receiver in Fix Frequency Mode 4.45

4.5.17 Total Harmonic Distortion 4.47

4.5.18 RSSI Squelch 4.50

4.5.19 Miscellaneous Functions 4.52

4.5.20 Antenna Tuning Unit 4.55
4.5.21 Spurious Emissions 4.56
4.5.22 Crossmodulation 4.58
4.5.23 Intemodulation Distortion 4.60
4.5.24 Weighted S/N Ratio 4.64
4.5.25 Image Rejection 4.65
4.5.26 Blocking 4.73

5 Replacement of Modules 5.1

5.1 Disassemble Procedures 5.1

5.2 Replacing Individual Modules 5.5

5.2.1 Radio Controller - Change 5.6
5.2.2 RF Unit - Change 5.10
5.2.3 Antenna Tuning Unit - Change 5.14
5.2.4 HF/VHF Power Amplifier - Change 5.18
5.2.5 VHF/UHF Power Amplifier - Change 5.23
5.2.6 Power Supply - Change 5.28
5.2.7 Front Panel - Change 5.32
5.2.8 Radio Controller - Battery - Change 5.34
5.2.9 Housing - Sealing Cords - Change 5.37

5.3 Assemble Procedures 5.38

6 System/Equipment Configuration 6.1

6.1 Load Software Procedures 6.1

6.1.1 General 6.1
6.1.2 Requisitions 6.1
6.1.2.1 Equipment specific SW/FW/HW 6.2
6.1.2.2 Optional Firmware Loading Equipment 6.3
6.1.3 Loading and Update Procedures 6.3
6.1.3.1 Hardware Configuration Setup 6.3
6.1.3.2 Software Download 6.5

6.2 Calibration 6.11

6.2.1 Changing the Frequency 6.15
6.2.2 Login Operation 6.17

7 Spare Parts 7.1

8 Drawings 8.1

List of Figures

Figure 2.1 Tactical Radio, Design 2.2
Figure 2.2 MR 300xH/U without Cover, Top 2.5
Figure 2.3 R&S MR 300xH without Cover and RF Unit, Top 2.6
Figure 2.4 MR 300xH without ATU, Cover, RF Unit and Intermediate Plate, Top 2.7
Figure 2.5 MR 3000H/U (mod. 02/03) without Cover, Bottom 2.8
Figure 2.6 Housing A9, Mod. 02, Top 2.9
Figure 2.7 Housing A9, Mod. 03, Top 2.10
Figure 2.8 Housing A9, Mod. 02 and 03, Bottom 2.11
Figure 2.9 Housing A9, Mod. 02 and 03, Front 2.12
Figure 2.10 Housing A9, Mod. 02, Rear 2.13
Figure 2.11 Housing A9, Mod. 03, Rear 2.14

Figure 3.1 MR 300xH/U, Cabling 3.4

Figure 4.1 R&S MR 300xH/U - Test Setup 1 ..... 4.3
Figure 4.2 R&S MR 300xH/U - Test Setup 2 ..... 4.4
Figure 4.3 Protective Caps for Connectors of R&S M3TR 4.7

Figure 5.1 Operating Position 5.2
Figure 5.2 Removing the Upper Cover 5.3
Figure 5.3 Removing the Lower Cover 5.4
Figure 5.4 Removing the Lower Cover 5.6
Figure 5.5 Radio Controller, Undoing Cables 5.7
Figure 5.6 Radio Controller, Undoing Screws 5.8
Figure 5.7 Radio Controller, Removal (only mod. 02/03) 5.9
Figure 5.8 Removing the Upper Cover 5.10
Figure 5.9 RF Unit, Removal 5.12
Figure 5.10 R&S MR 300xH Removing the Upper Cover 5.15
Figure 5.11 Antenna Tuning Unit, Undoing Screws 5.16
Figure 5.12 Antenna Tuning Unit, Removal 5.17
Figure 5.13 R&S MR300xH, Removing the Upper Cover 5.18
Figure 5.14 Power Amplifier, Undoing Screws 5.19
Figure 5.15 Power Amplifier, Removal 5.21
Figure 5.16 R&S MR300xU, Removing the Upper Cover 5.23
Figure 5.17 Power Amplifier, Undoing Screws 5.24
Figure 5.18 Power Amplifier, Removal 5.26
Figure 5.19 Removing the Lower Cover 5.29
Figure 5.20 Power Supply, Undoing Cables 5.30

Figure 5.21 Power Supply, Removal 5.31
Figure 5.22 Front Panel, Undoing Quick-Release Fasteners 5.32
Figure 5.23 R&S MR 3000U Front Panel, Removal 5.33
Figure 5.24 Removing the Lower Cover 5.34
Figure 5.25 Replacing the Backup Battery 5.35

Figure 6.1 Loading without Docking Station 6.4
Figure 6.2 Loading Configuration via the Docking Station Ethernet Interface at the Unit Frontside 6.4
Figure 6.3 Loading Configuration via the Serial Interface (DATA) at the Unit Frontside (not recommended) 6.5
Figure 6.4 Select a network adapter 6.6
Figure 6.5 Select configuration file 6.7
Figure 6.6 Select configuration file 6.8
Figure 6.7 Loading Configuration for SECOM H, SECOM V 6.10
Figure 6.8 Test Setup 6.12

List of Tables

Table 1.1 Difference between the Tactical Radios 1.2

Table 4.1 List of Test Equipment 4.1
Table 4.2 Leak Test 4.8
Table 4.3 Fault Isolation, Crossreference List 4.10
Table 4.4 Replacement, Crossreference List 4.11
Table 4.5 Power Consumption - Fault Detection 4.12
Table 4.6 MMI Function - Fault Isolation 4.16
Table 4.7 Audio Connector X4 Fault; Data Connector X5 - Fault Isolation 4.17
Table 4.8 HF-V/UHF Antenna - Fault Isolation 4.19
Table 4.9 GPS Connector X2 - Fault Isolation 4.20
Table 4.10 RF Power of Transmitter in Fix Frequency Mode - Fault Detection 4.21
Table 4.11 Power at Rear Connector X6 - Fault Detection 4.25
Table 4.12 Frequency Accuracy of Transmitter in Fix Frequency Mode - Fault Detection 4.26
Table 4.13 Harmonic Emission of Transmitter in Fix Frequency Mode - Fault Detection 4.27
Table 4.14 Transmitter Noise in Fix Frequency Mode - Fault Detection 4.28
Table 4.15 Two-tone Intermodulation of Transmitter in Fix Frequency Mode - Fault Detection 4.30
Table 4.16 VSWR Reduction of Transmitter in Fix Frequency Mode - Fault Detection 4.32
Table 4.17 Sensitivity of Receiver in Fix Frequency Mode - Fault Detection 4.34
Table 4.18 Desensitization of Receiver in Fix Frequency Mode - Fault Detection 4.40
Table 4.19 Frequency Response of Receiver in Fix Frequency Mode - Fault Detection 4.41
Table 4.20 IF Recjection of Receiver in Fix Frequency Mode - Fault Detection 4.45
Table 4.21 Total Harmonic Distortion - Fault Detection 4.47
Table 4.22 RSSI Squelch - Fault Detection 4.50
Table 4.23 Miscellaneous Functions - Fault Detection 4.52
Table 4.24 Antenna Tuning Unit - Fault Detection 4.55
Table 4.25 Spurious Emissions - Fault Detection 4.56
Table 4.26 Crossmodulation - Fault Detection 4.58
Table 4.27 Intemodulation Distortion - Fault Detection 4.60
Table 4.28 Weighted S/N Ratio - Fault Detection 4.64
Table 4.29 Image Rejection - Fault Detection 4.65
Table 4.30 Blocking - Fault Detection 4.73

Table 6.1 List of Test Equipment 6.11

Table 7.1 Spare Parts for R&S MR 3000H 7.1
Table 7.2 Spare Parts for R&S MR 3000U 7.3

1 General Data

This description deals with the following tactical radios:

- HF/VHF Tactical Radio R&S MR 3000H
- VHF/UHF Tactical Radio R&S MR 3000U
- HF/VHF Tactical Radio R&S MR 3001H
- VHF/UHF Tactical Radio R&S MR 3001U
- HF/VHF Tactical Radio R&S MR 3002H
- VHF/UHF Tactical Radio R&S MR 3002U
- HF/VHF Tactical Radio R&S MR 3003H
- VHF/UHF Tactical Radio R&S MR 3003U

The difference between the tactical radios are the are shown in the Table 1.1.

Table 1.1 Difference between the Tactical Radios

	R&S MR 3000H	R&S MR 3000U	R&S MR 3001H	R&S MR 3001U	R&S MR 3002H	R&S MR 3002U	R&S MR 3003H	R&S MR 3003U
Housing	X	X	X	X	X	X	X	X
Frontpanel	X	X	X	X	X	X	X	X
Power Amplifier HF/VHF	X		X		X		X	
Power Amplifier VHF/UHF (6096.1101.03)		X[2 3 4 5]		X[4]		X[4]		X[4]
Power Amplifier VHF/UHF (6140.7340.02)		X[6]		X[6]		X[6]		X[6]
ATU3	X[2]							
ATU4	X[3 4 6]		X[4 6]		X[4 6]		X[4 6]	
RF Unit	X	X	X	X	X	X	X	X
Radio Controller (6098.9200.02)	X[2 3]	X[2 3]						
Radio Controller (6126.4877.02)	X[4]	X[4]	X[4]	X[4]	X[4]	X[4]	X[4]	X[4]
Radio Controller (6140.7240.02)	X[6]	X[5 6]	X[6]	X[6]	X[6]	X[6]	X[6]	X[6]
Line Interface	X[2 3]	X[2 3]						
Power Supply	X[2]	X[2]						
Power Supply II	X[3 4 6]	X[3 4 5 6]	X[4 6]	X[4 6]	X[4 6]	X[4 6]	X[4 6]	X[4 6]
Protection Processor			X	X			X	X
DSP Extension Board					X	X	X	X

[2] = model 02

[3] = model 03

[4] = model 04

[5] = model 05

[6] = model 06

Therefore, here reference is mostly to the "tactical radio" in general, differences being pointed out, where necessary.

2 Construction

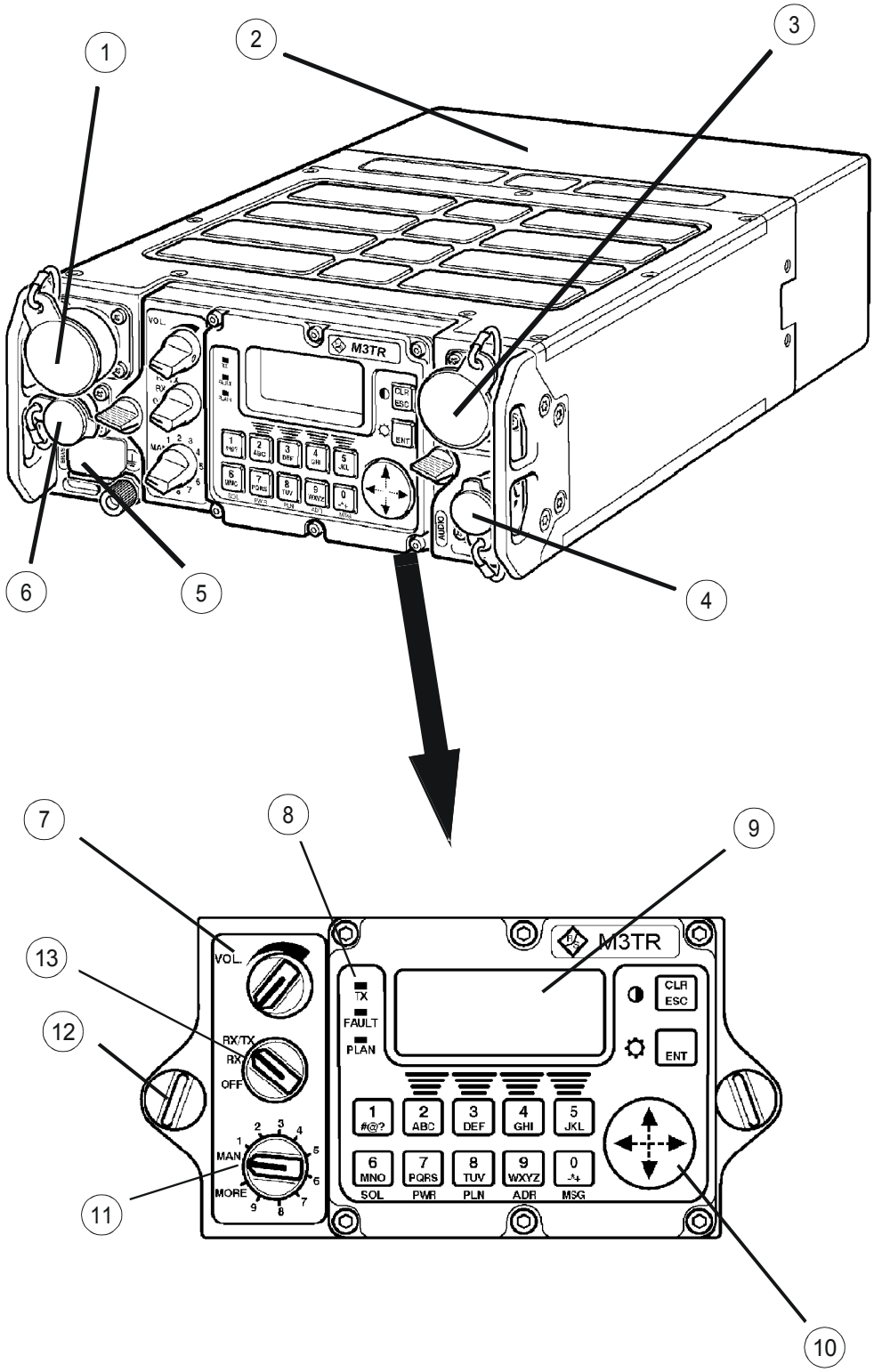
See Figure 2.1 to Figure 2.11

The radio consists of the following assemblies:

- Radio Controller A1
- Power Amplifier HF/VHF A2 (only for R&S MR 300xH)
- Power Amplifier VHF/UHF A2 (only for R&S MR 300xU)
- RF Unit A3
- Front Panel A4
- Power Supply A5
- Line Interface A6 (only mod. 02 and 03)
- ATU A10 (only for R&S MR 300xH)
- Protection Processor (only for R&S MR 3001H/U and R&S MR 3002H/U)
- DSP Extension Board (only for R&S MR 3002H/U and R&S MR 3003H/U

These modules are accommodated in the Housing A9, mod. 02 (with cables X28 and X29) or mod. 03 (without cables X28 and X29). At the rear of the housing the optional battery pack is installed and electrically connected with the radio.

Figure 2.1 Tactical Radio, Design



ICN-4G-A-231000-R-D0894-00002-A-01-1

1 HF/VHF/UHF Antenna Connection
1 Battery Pack
2 Data Connector
3 Audio/PTT Connector
4 Protective Flap (ERASE Key)
5 GPS Antenna Connection
6 Volume Control
7 LED's
8 Display
9 Menu Navigation Key
10 Preset Page Selector
11 Quick-release Fastener
12 Mode Switch

The modules of the tactical radio are accommodated in a shielding metal housing. Located in the left front part of the housing are antenna connectors (for HF/VHF/UHF, GPS) and an erase key (covered). At the right there are a data connector and an audio/PTT connector. Captive rubber caps are available to protect the antenna, data and audio/PTT connectors when they are not used.

The centre of the front is occupied by the detachable front panel, which is held in place by two quick-release fasteners. The front panel contains an LC display with illumination and the following control elements:

- Volume control
- Mode switch
- Preset page selector
- Menu navigation key
- Keypad with softkeys and keys for fixed functions

In addition, the front panel contains three LEDs to signal the following:

- TX
- FAULT
- PLAIN

Grips at the left and right are provided for transport.

At the rear of the housing there is the optional battery pack.

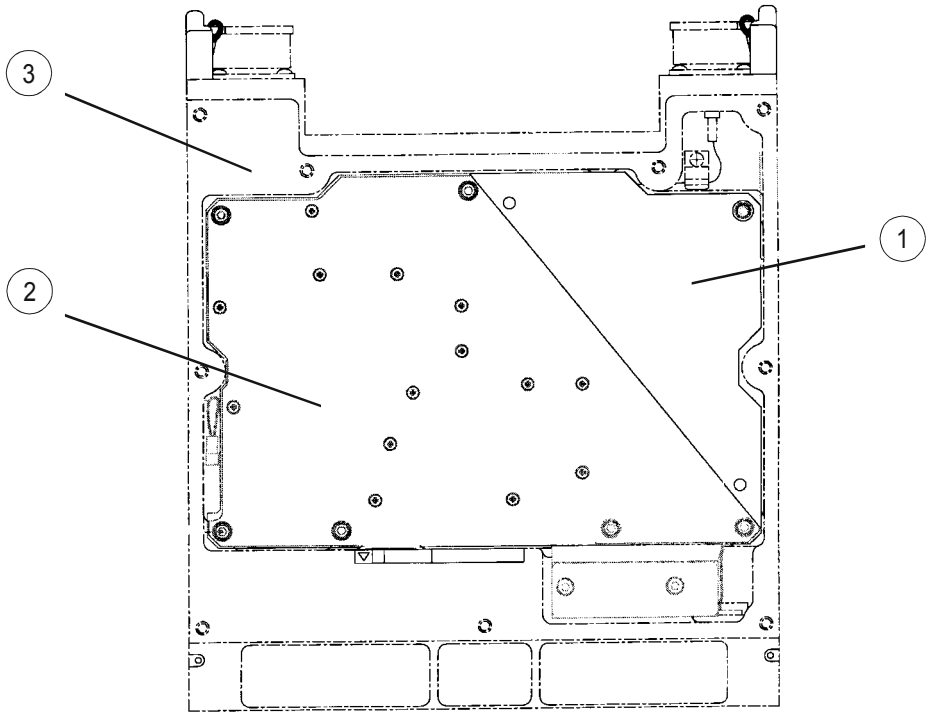
Modules A1 to A6 and module A10 (with R&S MR 300xH only) are accommodated in the Housing A9:

- Figure 2.1
- Figure 2.2
- Figure 2.3
- Figure 2.4
- Figure 2.5

The Housing A9 is designed as shown in:

- Figure 2.6
- Figure 2.7
- Figure 2.8
- Figure 2.9
- Figure 2.10
- Figure 2.11

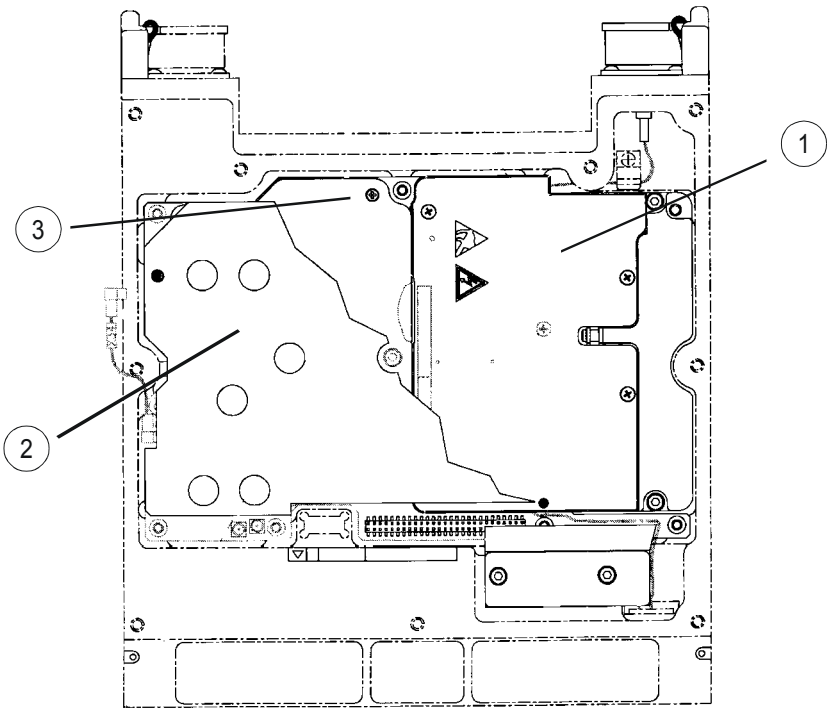
Figure 2.2 MR 300xH/U without Cover, Top



ICN-4G-A-231000-R-D0894-00003-A-01-1

1 Metal Cover (EMC protection)
2 RF Unit A3
3 Housing A9

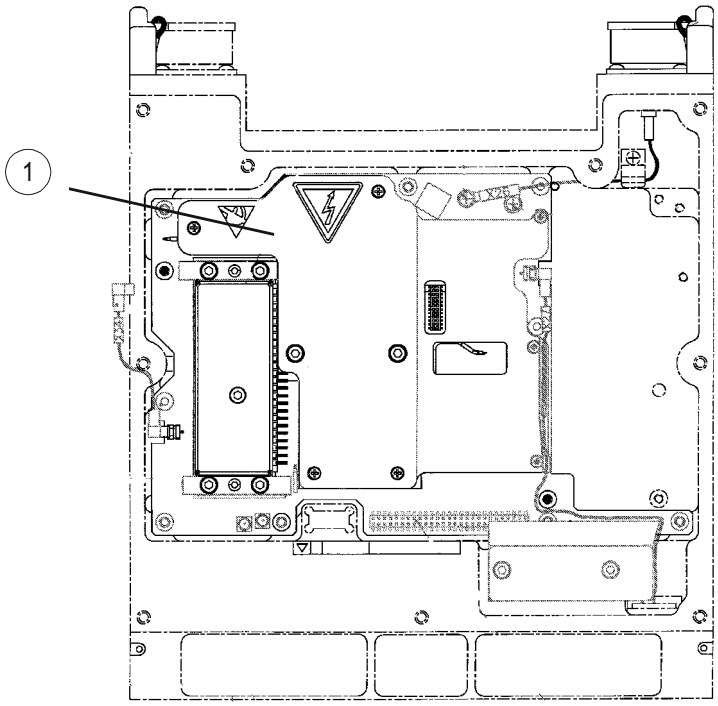
Figure 2.3 R&S MR 300xH without Cover and RF Unit, Top



ICN-4G-A-231000-R-D0894-20001-A-01-1

1 ATU A10 (R&S MR 300xH only)
2 Intermediate plate
3 Power Amplifier HF/VHF A2

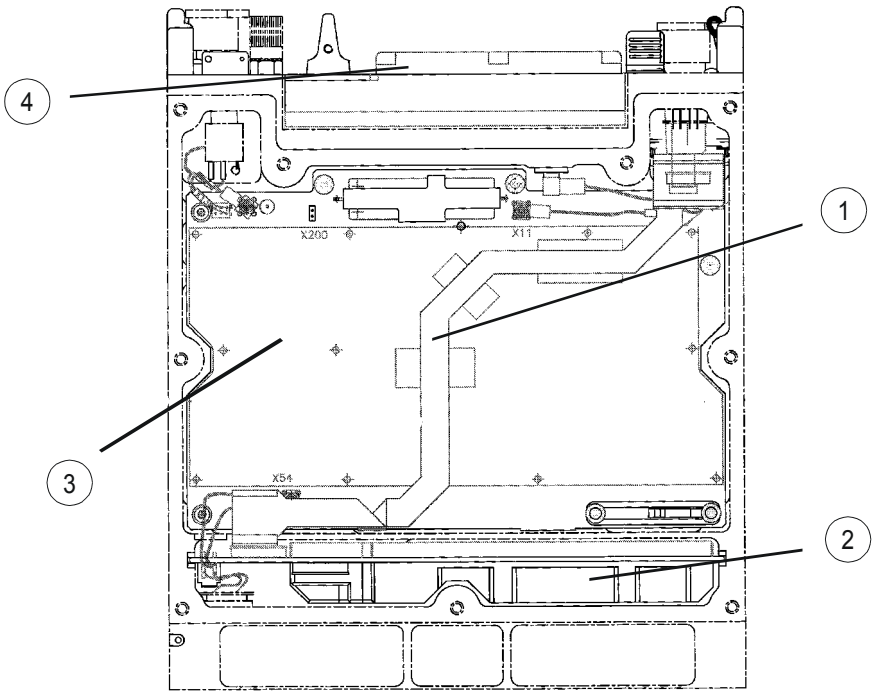
Figure 2.4 MR 300xH without ATU, Cover, RF Unit and Intermediate Plate, Top



ICN-4G-A-231000-R-D0894-00004-A-01-1

1 Power Amplifier HF/VHF A2

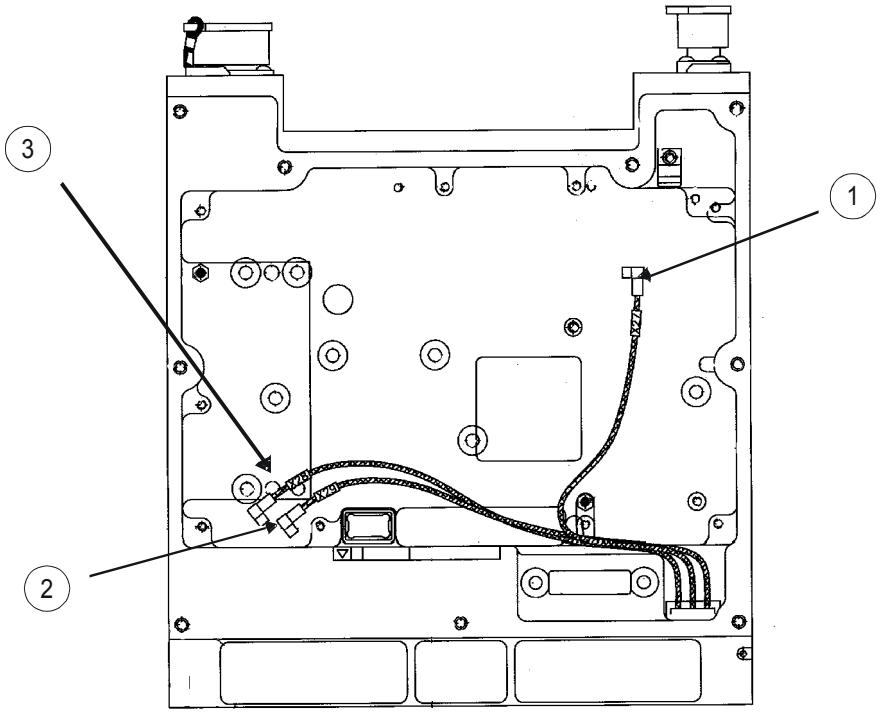
Figure 2.5 MR 3000H/U (mod. 02/03) without Cover, Bottom



ICN-4G-A-231000-R-D0894-00005-A-01-1

1 Line Interface A6
2 Power Supply A5
3 Radio Controller A1
4 Front Panel A4

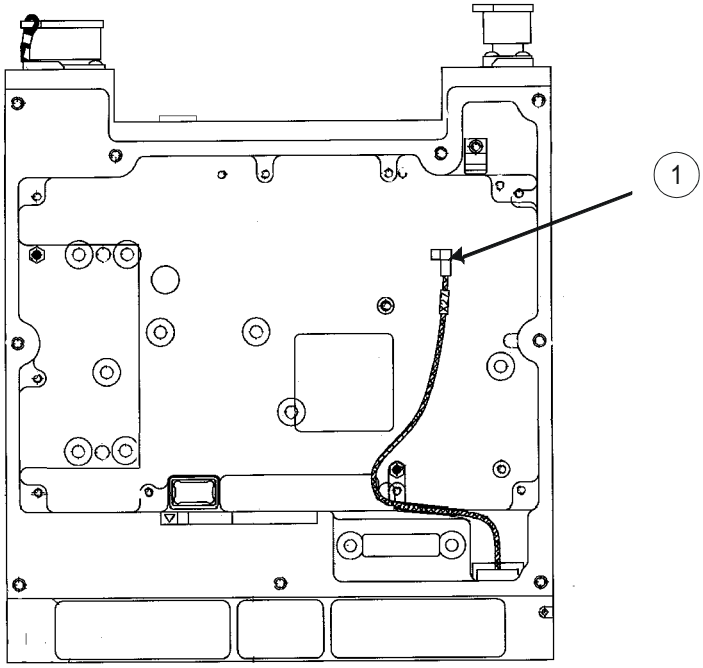
Figure 2.6 Housing A9, Mod. 02, Top



ICN-4G-A-231000-R-D0894-00010-A-01-1

1 X27 RF IN/OUT
2 X29 CARR.MAG
3 X28 ALC

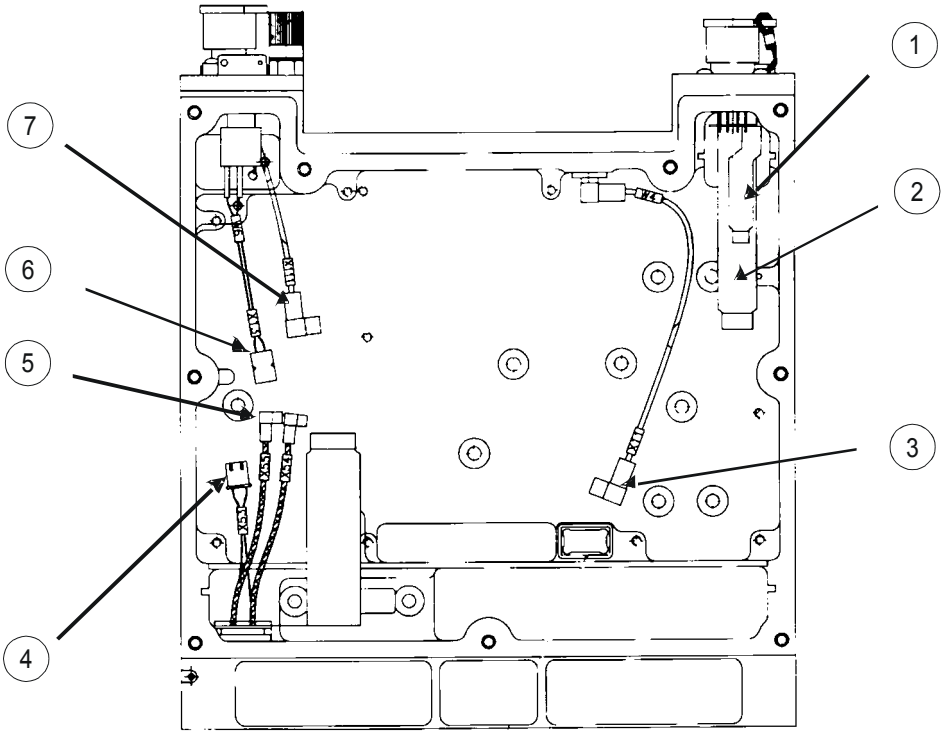
Figure 2.7 Housing A9, Mod. 03, Top



ICN-4G-A-231000-R-D0894-00011-A-01-1

1 X27 RF IN/OUT

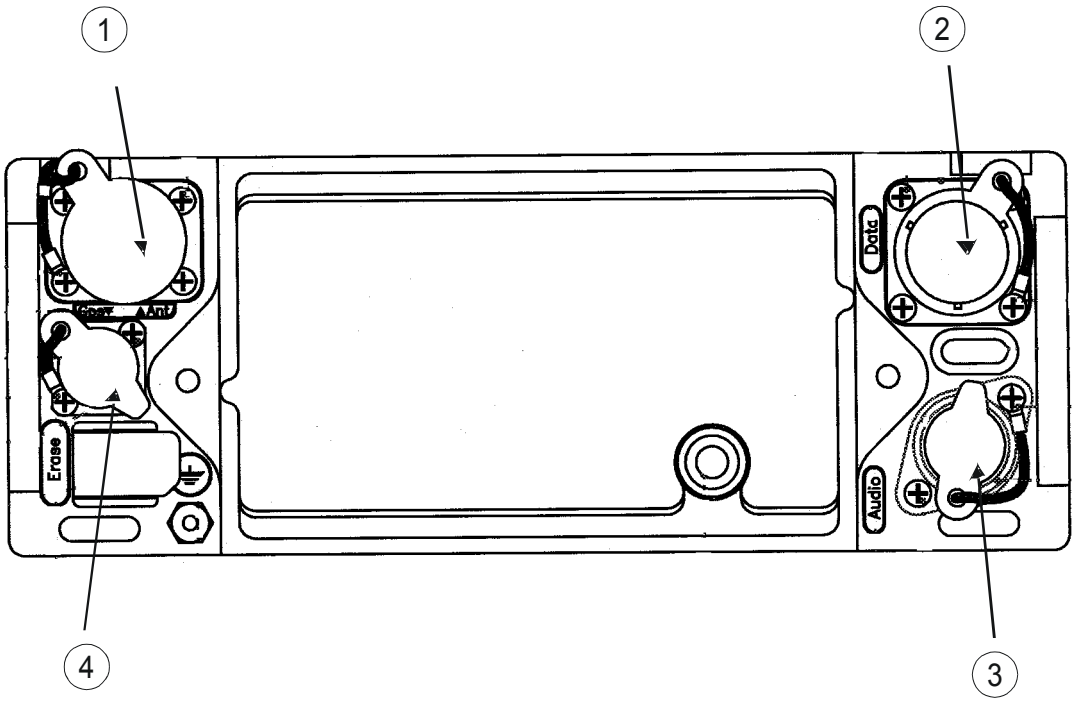
Figure 2.8 Housing A9, Mod. 02 and 03, Bottom



ICN-4G-A-231000-R-D0894-00012-A-01-1

1 from Audio X4 to Radio Controller X14 (Voice)
2 from Data X5 to Radio Controller X18 (Data)
3 X11 Front Panel
4 X53 VBATT_IN Power Supply
5 X54, X55 RCB_EXT Radio Controller
6 X13 from ERASE Switch
7 X111 from GPS Antenna Connector

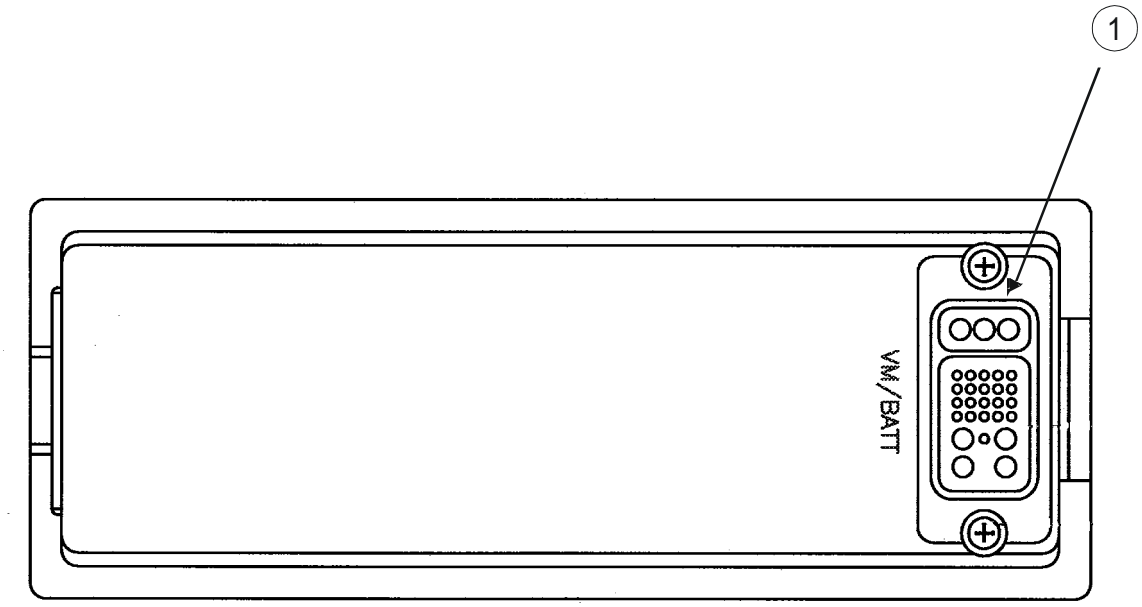
Figure 2.9 Housing A9, Mod. 02 and 03, Front



ICN-4G-A-231000-R-D0894-00013-A-01-1

1 HF / VHF / UHF Antenna Connection
2 Data Connection
3 Audio Connection
4 GPS Antenna Connection

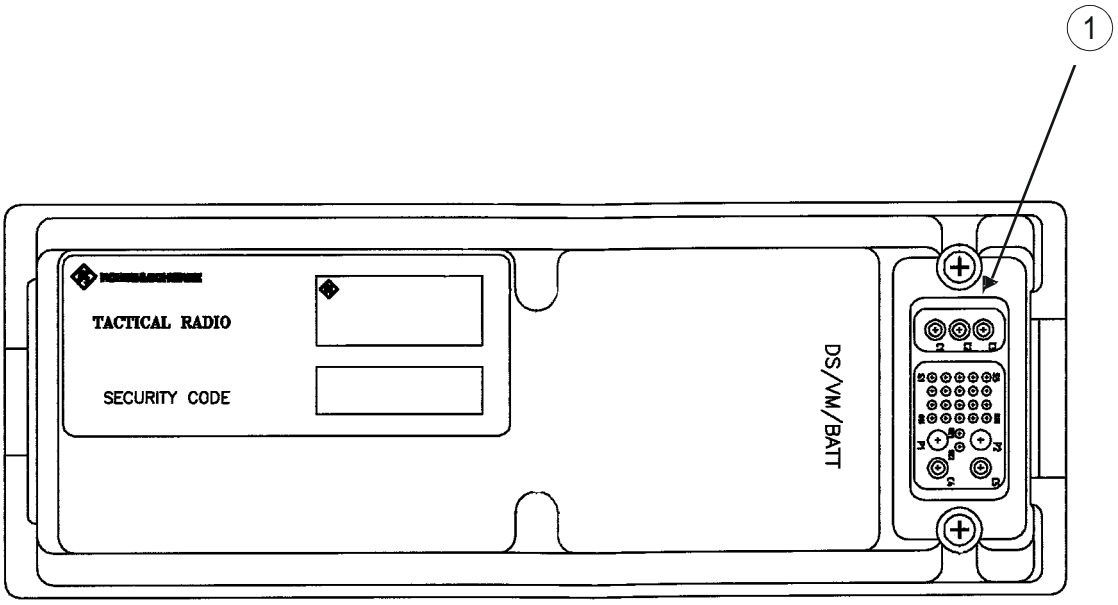
Figure 2.10 Housing A9, Mod. 02, Rear



ICN-4G-A-231000-R-D0894-00014-A-01-1

1 Battery Connection

Figure 2.11 Housing A9, Mod. 03, Rear



ICN-4G-A-231000-R-D0894-00015-A-01-1

1 Battery Connection

3 Function

(see circuit diagrams: sect. 8 Drawings)

The Radio Controller (RC) communicates with the other radio modules and controls all internal processes. It basically provides the following functions:

- Motherboard-like functions, distribution of signals for modules, submodules and optional modules, mechanical support for subassemblies
- Narrowband and wideband audio functions
- Provision of serial digital IF interface to RF modules
- AF and IF signal processing
- Provision of plain and secure link services, EPM operation
- Control of internal and external RF modules via the Radio Control Bus (RCB)
- Back-up and erase functions
- IBIT (Initiated Built-In Test), PBIT (Power-on Built-In Test), CM (Continuous Monitoring)
- Power management
- Provision of several external communication interfaces like RS232, RS422/ 485, Ethernet 10 / 100 Base T
- Filtering of internal and external interfaces

The Power Amplifier (PA) of the R&S MR 300xH amplifies the carrier frequency in the frequency range from 1.5 to 108.0 MHz with good linearity. The maximum output power is 20 W in the HF range (1.5 to 29.9 MHz) and 10 W in the VHF range (30.0 to 108.0 MHz). The power amplifier has an integrated harmonics filter. The Power Amplifier of the R&S MR 300xU amplifies the carrier frequency in the frequency range from 25 to 512 MHz with good linearity. The maximum output power is 10 W across the entire frequency range.

The Antenna Tuning Unit (ATU, R&S MR 300xH only) is directly connected with the power amplifier, providing for optimum power amplifier matching to the antenna.

The RF Unit (RFU) consists of the Synthesizer module (SYN) and the Frontend (FE). The synthesizer generates all frequencies required for correct tuning (local oscillator signals, clock signals). It covers the frequency ranges of 100 kHz to 512 MHz in reception and of 1.5 to 512 MHz in transmission. For this purpose the synthesizer contains a 10 MHz ±0.5 ppm reference oscillator. The frontend ensures digital I/Q modulation of the transmit signal and digitizing of the 3rd IF.

The Front Panel (FP) is the Man-Machine Interface (MMI) and also the audio interface of the radio. Operation is supported by control elements, a display and LEDs. Communication with the remote station is performed via the connected handset.

From the external battery voltage the Power Supply (PS) generates the voltages required for operation (+2.5 VDC, +3.3 VDC, +5 VDC, +6 VDC, -6 VDC, +8.2 VDC, +22 VDC, +150 VDC).

As optional battery either the Battery Pack (BP) R&S IB 3001with rechargeable Li-ion accumulators or the Battery Pack R&S IB 3002 with non-rechargeable $LiSO_2$ batteries may be connected.

The so called DSP extension board (DSPx) is located on the Radio Controller board and is used for providing additional HF house functionality as e.g. ALE3G or STANAG 4539.

The so called Protection Processor (HPP) is a board which is located on the Radio Controller and is used for waveforms SECOS and Have Quick.

3.1 Rx Signal Path

The receive signal from the antenna is fed in via RF socket X1 (ANT). Via cable W1 it is transferred to RF connector X26 of the power amplifier. During reception the transmit path of the power amplifier is blocked. Therefore the receive signal is taken via the power amplifier's internal filter with low attenuation to RF connector X24. Then the receive signal is routed via RF cable W7 and RF connector X34 to the frontend of the RF unit. In cooperation with the synthesizer, the frontend demodulates the receive signal and digitizes the 3rd IF. For further conversion the 3rd IF is made available to the radio controller. Here it is demodulated to obtain analog and digital signals for the data connector X5, analog AF signals for the audio connector X4 and a serially coded signal.

The serially coded signal is taken via connector X11, cable W4 and connectors X7 and X8 to the front panel.

The analog (LINE_RX) and digital (V.24, V.10) signals for data connector X5 are routed from connector X18 of the radio controller to the external connector X5 (DATA) where they may be tapped for further processing.

The analog AF signals are routed from connector X14 of the radio controller to the external connector X4 (AUDIO) of the radio.

Via a separate GPS antenna time signals for synchronizing the radio may be received. These signals are taken from the GPS antenna via RF socket X2 (GPS ANT), cable W2 and RF connector X111 to the radio controller. Here the GPS signals are processed by a GPS receiver circuit.

3.2 Tx Signal Path

Signals processed for transmission may be analog microphone signals, analog signals from the external connector X4 (AUDIO) or digital and analog signals from the external connector X5 (DATA).

Analog microphone signals are taken to the FP Control subassembly of the front panel. They are converted into serial signals and fed via X8, X7, cable W4 and X11 to the radio controller.

Analog signals fed in at connector X4 (AUDIO) are taken via X14 to the radio controller. Analog (LINE_TX) and digital (V.24, V.10) signals fed in at connector X5 are taken via X18 also to the radio controller.

In the radio controller the signals are converted and routed as modulation signals via X12 and X13 to the power amplifier. The synthesizer of the RF unit generates a signal with the desired transmit frequency and routes it via X41 and X21 also to the power amplifier. The modulated carrier frequency at X26 of the power amplifier is taken via cable W1 and RF socket X1 (ANT) to the antenna.

For optimum antenna matching to the power amplifier, the antenna tuning unit is used (R&S MR 3000H only). It is connected to the power amplifier via X212 and X22.

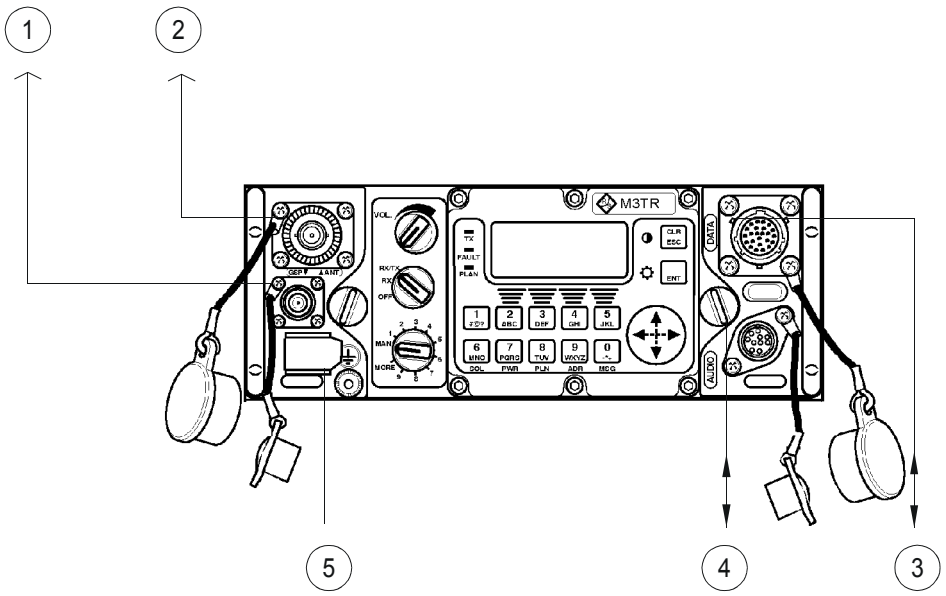
3.3 Settings and Cabling

3.3.1 General

All required settings of operating modes and functions are tailor-made at the factory in compliance with the customer's specifications.

3.3.2 MR 300xH/U Cabling

Figure 3.1 MR 300xH/U, Cabling



ICN-4G-A-231000-R-D0894-00007-A-01-1

1 GPS Antenna
2 HF/VHF/UHF Antenna
3 DATA Terminal
4 Headset
5 Ground

The MR 300xH/U is to be cabled as follows:

- ANT (X1): connection of HF/VHF antenna for R&S MR 300xH or of VHF/UHF antenna for R&S MR 300xU
- GPS (X2): connection of GPS antenna
- DATA (X5): connection of data terminal (e.g. laptop)
- AUDIO (X4): connection of headset with PTT key
- Ground: connection of system ground for stationary use

4 Maintenance

4.1 Test Equipment, Tools and Software

NOTICE

Equivalent test equipment may be used. Special tools are not required.

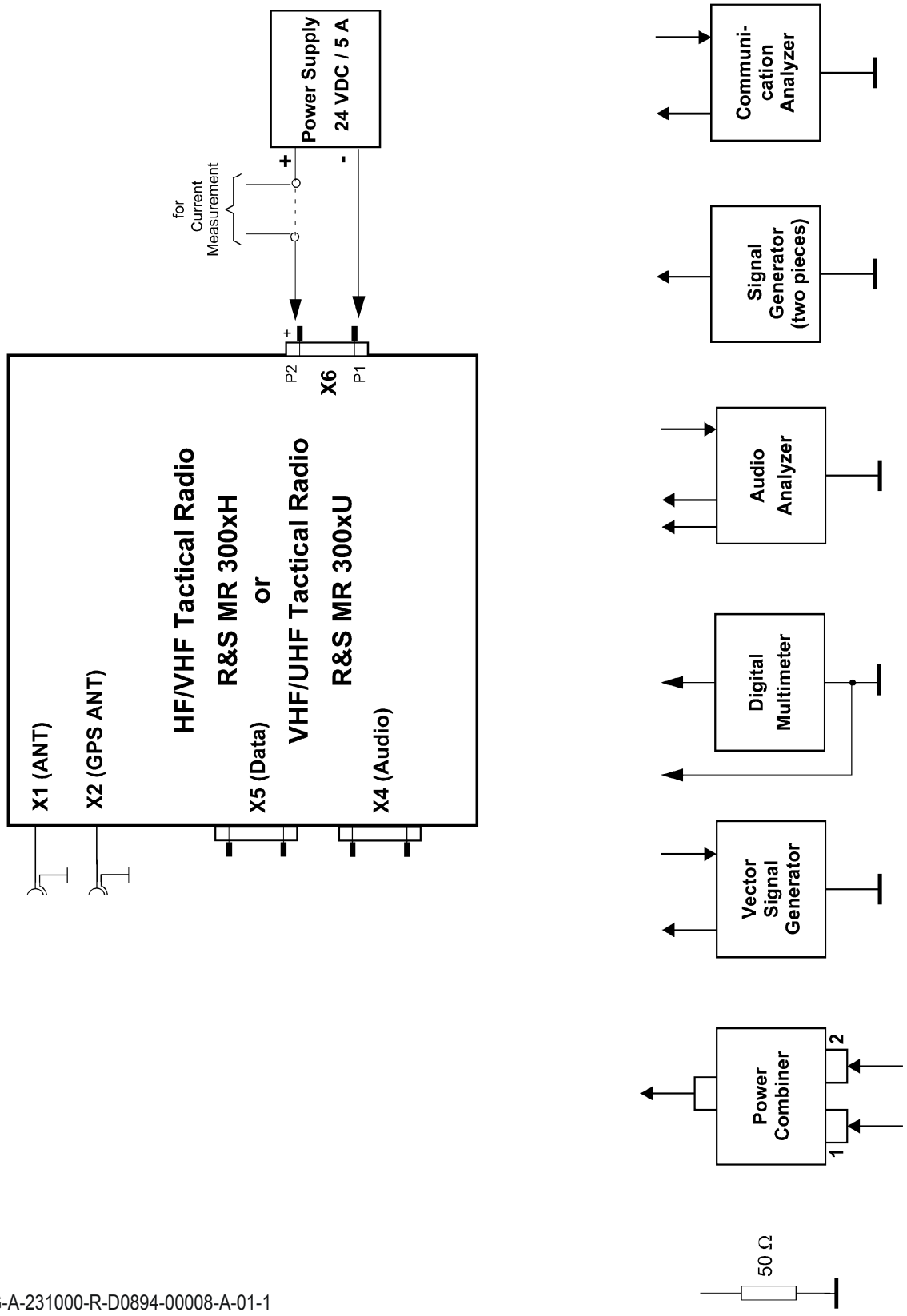
Table 4.1 List of Test Equipment

Item	Test equipment, required data	Equipment recommended by Rohde & Schwarz	Ordering code
1	Power supply 24 VDC, 5 A	R&S NGB 32	117.7210.90
2	Digital multimeter 0 to 30 VDC, 0 to 3.5 A	R&S UDL 35	1037.1807.02
3	Audio analyzer with internal generator 0 to 20 kHz	R&S UPA 3	0372.6014.03
4	Signal generator	R&S SMT 02	1039.2000.02
5	Communication analyzer	R&S CMTA 54	0834.0000.54
6	Load 50 Ω/500 W	conventional workshop model	-
7	Vector signal generator with unit for BER measurement	R&S SMIQB21 R&S SMIQ 02B	1125.5555.02 1125.5490.02
8	Attenuators 6 dB and 20 dB	conventional workshop model	-
9	Notch filter	conventional workshop model	-
10	Immersion tank (inside colour: black; good underwater illumination; underwater mirror) WxHxD:>199x74x300 mm	conventional workshop model	-
11	Climate chamber	Hereus HT4010	-
12	Atmospheric pressure difference measurement system	Schreiner LPC 820	-
13	Test chamber for pressure drop	conventional workshop model	-
14	Power combiner	conventional workshop model	-

4.2 Test Setup

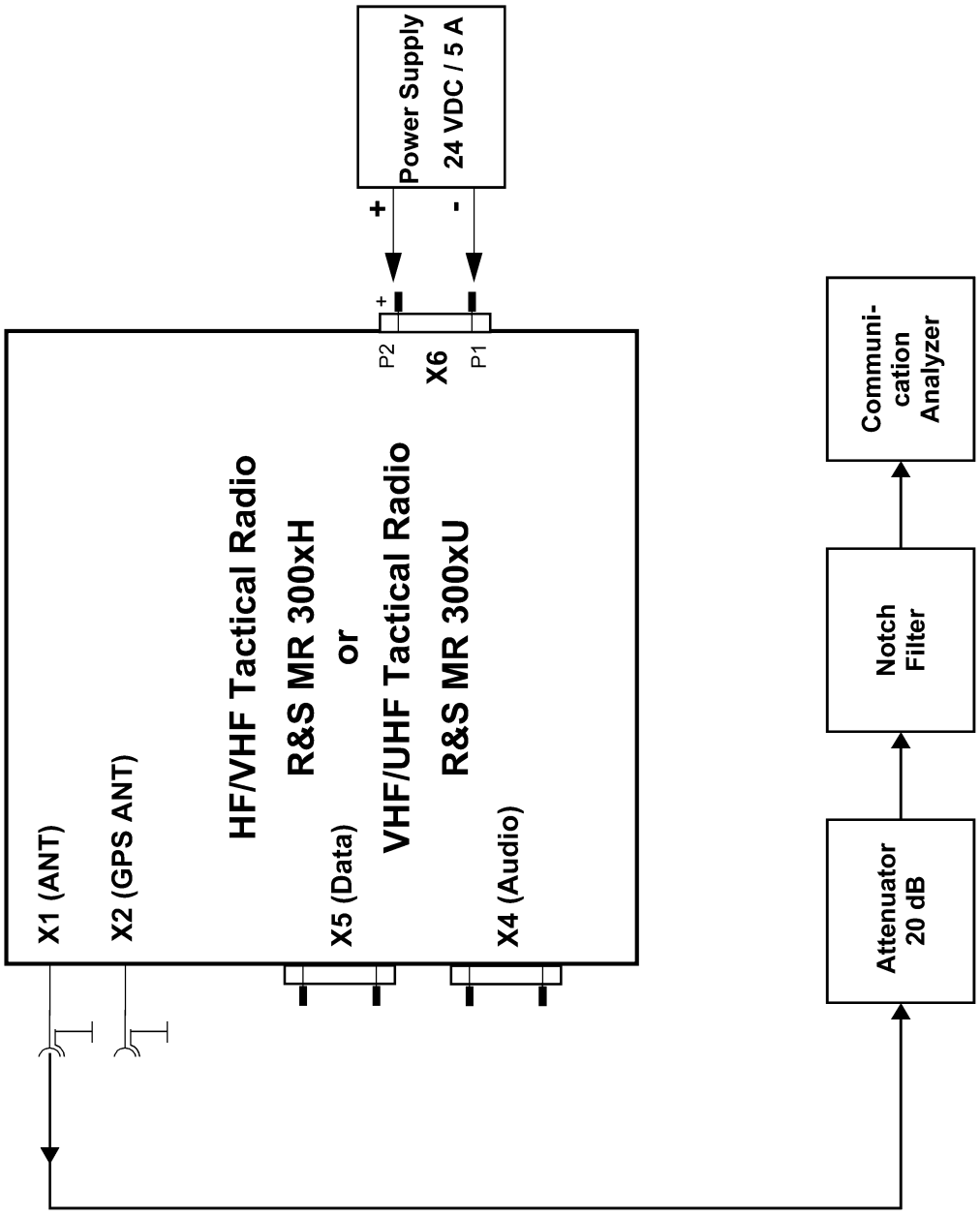
1. Arrange test setup Figure 4.1 or Figure 4.2 respectively.

Figure 4.1 R&S MR 300xH/U - Test Setup 1



ICN-4G-A-231000-R-D0894-00008-A-01-1

Figure 4.2 R&S MR 300xH/U - Test Setup 2



ICN-4G-A-231000-R-D0894-00009-A-01-1

2 Switch on test equipment and Radio.

4.3 Visual Examinations

CAUTION

If a connector shows any discolouration caused by heat, its mating connector is also defective. Both must therefore be replaced.

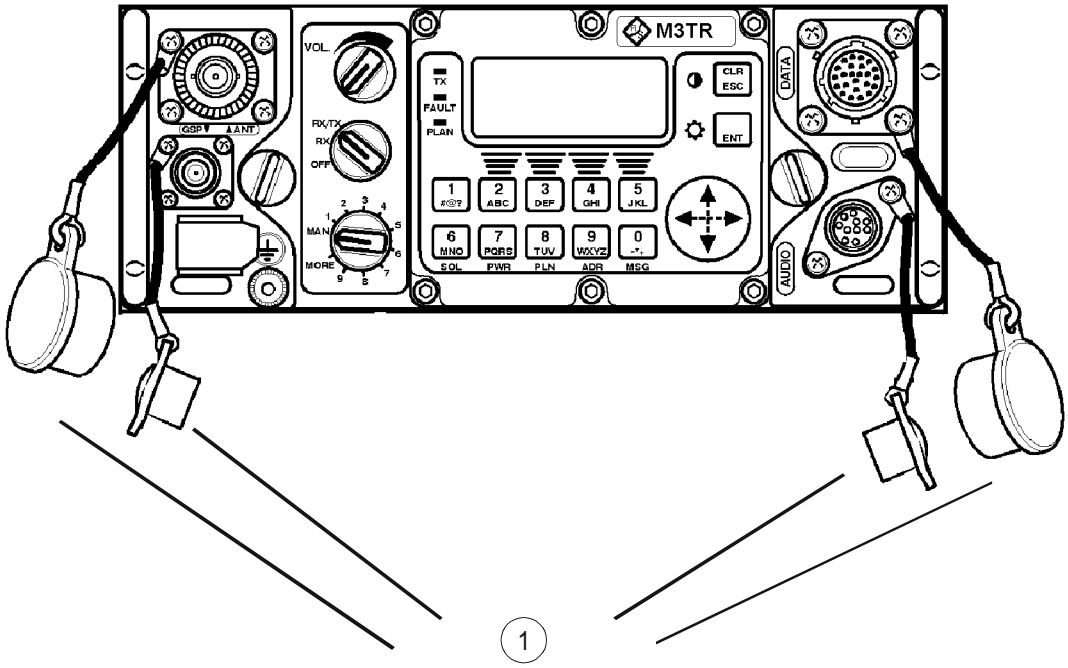
Examine the protective caps of the connectors at the front of R&S M3TR every two years if a white film has formed on the surface. When such a film is detected it is absolutely mandatory to replace the affected caps. Dispose of the replaced caps in line with the waste disposal regulations in force.

NOTICE

To eliminate any faults replace the module(s) found to be defective. If the fault persists, the entire unit will have to be replaced.

- Make sure that all screws are present. Replace any missing screws.
- Carefully examine connectors for broken, corroded or bent contacts, pins or sockets. If necessary, replace defective connector(s).

Figure 4.3 Protective Caps for Connectors of R&S M3TR



ICN-4G-A-231000-R-D0894-20002-A-01-1

1 Caps for Connectors

4.4 Leak Test

1.

CAUTION

Before starting the pressure drop measurement and immersion test make absolutely sure that the tactical radio is disconnected from power! Pull off all external cables and put the protective caps on the connectors. The pressure drop measurement must be carried out before the immersion test.

NOTICE

This test only needs to be performed if the tactical radio was opened for troubleshooting, fault elimination and/or replacement of modules.

The immersion test as described below complies with the following standard:

MIL-STD810E method 512.3, procedure I-Basic Leakage, 1 m depth, 2 hours

Carry out the test steps listed in the table Table 4.2.

Table 4.2 Leak Test

No.	Activity / fault elimination	Nominal value
1.	Preparation	
1.1	Put the tactical radio into the test chamber and close the test chamber tight.	
1.2	Set the test pressure of the test chamber to 200 mbar.	
1.3	Set the test duration to 100 sec.	
2.	Leakage Rate Test	
2.1	Using the pressure difference meter, check the required leakage rate L at a chamber volume of 930 ±20 ml: Leakage rate L: Possible cause of fault: tactical radio is leaking Fault elimination: Replace defective R&S M3TR.	-0.6 to 0 Nccm/min
3.	Immersion Test	
3.1	Put the tactical radio in a climate chamber and allow to cool down to +5 °C for approximately one hour.	
3.2	Fill the immersion basin with water. Heat the water to +25 ±2 °C.	

No.	Activity / fault elimination	Nominal value
3.3	Immerse the cooled tactical radio completely in the basin for ≥ 5 min.	
3.4	Observe the tactical radio in the immersion basin and check for air bubbles rising from the housing. Possible cause of fault: Leaking connectors and/or seals Fault elimination: Replace connector(s) and/or seals sect. 5.2.9 Housing - Sealing Cords - Change.	no air bubbles
3.5	Remove the tactical radio from the immersion basin and allow it to dry in the climate chamber at +50 °C for approximately 1 min.	

4.5 General Fault Isolation Procedures

Troubleshooting on the tactical radio commences with a visual inspection (sect. 4.3 Visual Examinations). If these measures fail to detect the fault, continue troubleshooting acc. to Table 4.3.

Table 4.3 Fault Isolation, Crossreference List

Power Consumption	sect. 4.5.1 Power Consumption
Man Machine Interface Function	sect. 4.5.2 Man Machine Interface Function
Audio Connector X4 and/or Data Connector X5	sect. 4.5.3 Audio Connector X4 and/or Data Connector X5
HF-V/UHF Antenna Switch	sect. 4.5.4 HF-V/UHF Antenna Switch
GPS Connector X2	sect. 4.5.5 GPS Connector X2
RF Transistor or Transmitter in Fix Frequency Mode	sect. 4.5.6 RF Power of Transmitter in Fix Frequency Mode
Power at REAR Connector X6	sect. 4.5.7 Power at Rear Connector X6
Frequency Accuracy of Transmitter in Fix Frequency Mode	sect. 4.5.8 Frequency Accuracy of Transmitter in Fix Frequency Mode
Harmonic Emission of Transmitter in Fix Frequency Mode	sect. 4.5.9 Harmonic Emission of Transmitter in Fix Frequency Mode
Transmitter Noise in Fix Frequency Mode	sect. 4.5.10 Transmitter Noise in Fix Frequency Mode
Two-tone Intermodulation of Transmitter in Fix Frequency Mode	sect. 4.5.11 Two-tone Intermodulation of Transmitter in Fix Frequency Mode
VSWR Reduction of Transmitter in Fix Frequency Mode	sect. 4.5.12 VSWR Reduction of Transmitter in Fix Frequency Mode
Sensitivity of Receiver in Fix Frequency Mode	sect. 4.5.13 Sensitivity of Receiver in Fix Frequency Mode
Desensitization of Receiver in Fix Frequency Mode	sect. 4.5.14 Desensitization of Receiver in Fix Frequency Mode
Frequency Response of Receiver in Fix Frequency Mode	sect. 4.5.15 Frequency Response of Receiver in Fix Frequency Mode
IF Rejection of Receiver in Fix Frequency Mode	sect. 4.5.16 IF Recjection of Receiver in Fix Frequency Mode
Total Harmonic Distortion	sect. 4.5.17 Total Harmonic Distortion
RSSI Squelch	sect. 4.5.18 RSSI Squelch
Miscellaneous Functions	sect. 4.5.19 Miscellaneous Functions
Antenna Tuning Unit	sect. 4.5.20 Antenna Tuning Unit
Spurious Emissions	sect. 4.5.21 Spurious Emissions
Crossmodulation	sect. 4.5.22 Crossmodulation
Intemodulation Distortion	sect. 4.5.23 Intemodulation Distortion
Weighted S/N Ratio	sect. 4.5.24 Weighted S/N Ratio
Image Rejection	sect. 4.5.25 Image Rejection
Blocking	sect. 4.5.26 Blocking

For fault elimination replace the module which was found to be defective or continue in accordance with the Service Manual of the module concerned Table 4.4.

Table 4.4 Replacement, Crossreference List

R&S M3TR, Disassembly	sect. 5 Replacement of Modules
R&S M3TR, Assembly	sect. 5.3 Assemble Procedures
Radio Controller	sect. 5.2.1 Radio Controller - Change
HF/VHF Power Amplifier	sect. 5.2.4 HF/VHF Power Amplifier - Change
VHF/UHF Power Amplifier	sect. 5.2.5 VHF/UHF Power Amplifier - Change
RF Unit	sect. 5.2.2 RF Unit - Change
Front Panel	sect. 5.2.7 Front Panel - Change
Power Supply	sect. 5.2.6 Power Supply - Change
Antenna Tuning Unit	sect. 5.2.3 Antenna Tuning Unit - Change
Sealing Cords	sect. 5.2.9 Housing - Sealing Cords - Change
Battery	sect. 5.2.8 Radio Controller - Battery - Change

NOTICE

Do not use the antenna connected at R&S M3TR as a handle to carry the radio to another location (e.g. to the service depot). Carrying the radio at the antenna may damage the tuning filter mechanically.

In case that R&S M3TR was opened for troubleshooting, fault elimination and/or replacement of modules/components, it is absolutely mandatory to check it for tightness after reassembly.

For this perform the pressure drop measurement and immersion test detailed in sect. 4.4 Leak Test.

4.5.1 Power Consumption

1. Carry out the test steps: Table 4.5

Table 4.5 Power Consumption - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup.		
1.3	Only R&S R&S MR 300xU: Activate (high level) VM_DETECT at X6.S11 (rear connector).		
1.2	Switch on test equipment and radio.		
2.	Current Consumption - Power OFF Mode		
2.1	At the radio set the following:		
	Mode switch:	OFF	
2.2	By using the digital multimeter (ammeter) check the current. **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		≤ 2 mA
3.	Current Consumption - Receive Mode		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	10.1 MHz (R&S MR 300xH)	
		60.125 MHz (R&S MR 300xH/U)	
		185.1 MHz (R&S MR 300xU)	
3.2	By using the digital multimeter (ammeter) check the current. Temperature range 0 to 70° C R&S MR 3000H (without HPP and DSP) R&S MR 300xH (x = 1 to 3, with HPP and/or DSP) Temperature range 0 to -40° C R&S MR 3000H (without HPP and DSP) R&S MR 300xH (x = 1 to 3, with HPP and/or DSP) **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		 < 0.4 A < 0.45 A < 0.6 A < 0.65 A
3.3	At the radio set a frequency of 60.125 MHz (R&S MR 300xH/U) and 185.1 MHz (R&S MR 300xU).		

No.	Activity / fault elimination		Nominal value
3.4	By using the digital multimeter (ammeter) check the current. Temperature range 0 to 70° C R&S MR 3000H (without HPP and DSP) R&S MR 300xH (x = 1 to 3, with HPP and/or DSP) Temperature range 0 to 50° C R&S MR 3000U (without HPP and DSP) R&S MR 300xU (x = 1 to 3, with HPP and/or DSP) Temperature range 50 to 70° C Only R&S MR 300xU: In temperature range 50 to 70° C the current (from temperature range 0 to 50° C) can increase at 0.02 A. Temperature range 0 to -40° C R&S MR 3000H/U (without HPP and DSP) R&S MR 300xH/U (x = 1 to 3, with HPP and/or DSP) **NOTICE** **Increased current because of Front Panel Display heating.** **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		< 0.4 A < 0.45 A < 0.42 A < 0.45 A < 0.6 A < 0.65 A
4.	Current Consumption - Transmit Mode, Modulation +J3E		
4.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	10.1 MHz (R&S MR 300xH)	
		60.125 MHz (R&S MR 300xU)	
	Signal power:	20 W_{PEP} (R&S MR 300xH)	
		10 W_{PEP} (R&S MR 300xU)	
	Modulation:	+J3E	
4.2	At X5.1 (LINE_TX-) and X5.22 (LINE_TX+) connect AF generator of audio analyzer and feed in two signals simultaneously with the following parameters:		
	f_{audio1}:	1 kHz	
	f_{audio2}:	1.8 kHz	
	Signal level:	0 dBm into 600 Ω	

No.	Activity / fault elimination		Nominal value
4.3	By using the digital multimeter (ammeter) check the current. **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		< 3.3 A (R&S MR 300xH) < 3.0 A (R&S MR 300xU)
5.	Current Consumption - Transmit Mode, Modulation F3E		
5.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	60.125 MHz (R&S MR 300xH)	
		185.1 MHz (R&S MR 300xU)	
	Signal power:	10 W	
	Modulation:	F3E	
5.2	By using the digital multimeter (ammeter) check the current. **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		< 2.5 A (R&S MR 300xH) < 2.2 A (R&S MR 300xU)
5.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	60.1 MHz (R&S MR 300xH)	
		185.1 MHz (R&S MR 300xU)	
	Signal power:	5 W	
	Modulation:	F3E	
5.4	By using the digital multimeter (ammeter) check the current. **Possible cause of fault:** Module power supply (A5) and/or connected modules defective		< 1.3 A (R&S MR 300xH) < 1.5 A (R&S MR 300xU)
6.	Current Consumption - Standby Mode, Modulation F3E		
6.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	STANDBY	
	Frequency:	60.125 MHz	
	Modulation:	F3E	

No.	Activity / fault elimination	Nominal value
6.2	By using the digital multimeter (ammeter) check the current. R&S MR 3000H/U (without HPP and DSP) R&S MR 3000H/U (x = 1 to 3, with HPP and/or DSP) **Possible cause of fault:** Module power supply (A5) and/or connected modules defective	 0.1 to 0.22 A 0.1 to 0.27 A
6.3	Switch off test equipment and disconnect radio from test setup.	
6.4	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.2 Man Machine Interface Function.	

4.5.2 Man Machine Interface Function

1. Carry out the test steps: Table 4.6

Table 4.6 MMI Function - Fault Isolation

No.	Activity / fault elimination	Nominal value
1.	Preparations	
1.1	Arrange test setup sect. 4.2 Test Setup	
1.2	Switch on power supply and radio.	
2.	Brightness and Contrast	
2.1	Check readability of display by adjusting brightness and contrast. Adjust brightness and contrast. **Possible cause of fault:** Module front panel (A4) and/or connected modules defective	brightness and contrast both adjustable
2.2	Switch off power supply and disconnect radio from test setup.	
2.3	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.3 Audio Connector X4 and/or Data Connector X5.	

4.5.3 Audio Connector X4 and/or Data Connector X5

1. Carry out the test steps: Table 4.7

Table 4.7 Audio Connector X4 Fault; Data Connector X5 - Fault Isolation

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	42.1 MHz	
	Modulation:	F3E	
	f_{dev}:	5 kHz	
	Volume control:	maximum volume	
1.4	Connect signal generator at X1 (ANT) and feed in FM signal with the following parameters:		
	Frequency:	42.1 MHz	
	Signal level:	-40 dBm	
	f_{audio}:	1 kHz	
	f_{dev}:	5 kHz	
2.	Audio RX Output of Audio Connector X4		
2.1	By using the audio analyzer at X4.B (AUDIO_RX) check frequency and signal voltage of output signal into 600 Ω. **Possible cause of fault:** Module RF unit (A3), radio controller (A1) and/or connected modules defective		f_{audio} = 1 kHz, 1.7 to 4.5 V (R&S MR 300xH) 1.7 to 4.0 V (R&S MR 300xU)
2.2	Disconnect signal generator from X1 (ANT).		
3.	Battery Voltage VBATT of Audio Connector X4		
3.1	By using the digital multimeter (voltmeter) at X4.E (VBATT) check operating voltage. **NOTICE** **For this measurement the load at DC output VBATT X4.E is 150 Ω.** **Possible cause of fault:** Module power supply (A5), radio controller (A1) and/or connected modules defective		24 VDC ±5%

No.	Activity / fault elimination	Nominal value
4.	Battery Voltage VBATT of Data Connector X5	
4.1	By using the digital multimeter (voltmeter) at X5.20 (V_{BATT}) check operating voltage. **NOTICE** **For this measurement the load at DC output VBATT X5.20 is 150 Ω.** **Possible cause of fault:** Module power supply (A5), radio controller (A1) and/or connected modules defective	24 VDC ±5%
4.2	Switch off test equipment and disconnect radio from test setup.	
4.3	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.4 HF-V/UHF Antenna Switch.	

4.5.4 HF-V/UHF Antenna Switch

1. Carry out the test steps: Table 4.8

Table 4.8 HF-V/UHF Antenna - Fault Isolation

No.	Activity / fault elimination	Nominal value
1.	Preparations	
1.1	Arrange test setup sect. 4.2 Test Setup	
1.2	Switch on test equipment and radio.	
2.	HF-V/UHF Antenna Switch	
2.1	Connect connector contact X6.S15 (HF-V/UHF contact of rear connector) at AF input of audio analyzer.	
2.2	At the radio set HF mode (frequency < 30 MHz).	
2.3	By using the audio analyzer at X6.S15 check voltage. **Possible cause of fault:** Module radio controller (A1) and/or connected modules defective	3.3 V
2.4	At the radio set V/UHF mode (frequency > 30 MHz).	
2.5	By using the audio analyzer at X6.S15 check voltage. **Possible cause of fault:** Module radio controller (A1) and/or connected modules defective	0 V
2.6	Switch off test equipment and disconnect radio from test setup.	
2.7	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.5 GPS Connector X2.	

4.5.5 GPS Connector X2

1. Carry out the test steps: Table 4.9

Table 4.9 GPS Connector X2 - Fault Isolation

No.	Activity / fault elimination	Nominal value
1.	Preparations	
1.1	Arrange test setup sect. 4.2 Test Setup	
1.2	Switch on power supply and radio.	
2.	GPS Connector X2	
2.1	Connect GPS antenna at RF socket X2 (GPS ANT).	
2.2	Check display for correct connection of GPS antenna. This may take 5 minutes + 1 minute! **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective	correct position, time and velocity
2.3	Switch off power supply and disconnect radio from test setup.	
2.4	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.6 RF Power of Transmitter in Fix Frequency Mode.	

4.5.6 RF Power of Transmitter in Fix Frequency Mode

1. Carry out the test steps: Table 4.10

Table 4.10 RF Power of Transmitter in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	PEP in SSB Mode		
2.1	At X5.1 (LINE_TX-) and X5.22 (LINE_TX+) connect AF generator of audio analyzer and feed in two signals simultaneously with the following parameters:		
	f_{audio1}:	1 kHz	
	f_{audio2}:	1.8 kHz	
	Signal level:	-6 dBm into 600 Ω	
2.2	At X1 (ANT) connect power meter input of communication analyzer.		
2.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	variable (see below)	
	Output power:	variable (see below)	
	Modulation:	+J3E	
	Information displayed:	RF→ FRONT	
2.4	At the radio set output power to 20 W_{PEP} (R&S MR300xH) or 10 W_{PEP} (R&S MR300xU) and set the following transmit frequencies in succession: Frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz and 29.9 MHz (R&S MR300xH) 25.1 MHz, 42.1 MHz, 70.1 MHz and 107.9 MHz (R&S MR300xU) By using the communication analyzer check the output power at X1 for each frequency. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) (only R&S MR300xH) and/or connected modules defective		20 W_{PEP} ±1 dB (R&S MR300xH) 10 W_{PEP} ±1 d (R&S MR300xU)

No.	Activity / fault elimination	Nominal value
2.5	At the radio set a transmit frequency of 1.983 MHz (R&S MR300xH) or 25.1 MHz (R&S MR300xU) and set the following output powers in succession. By using the communication analyzer check the output power at X1. Output power:	
	10 W_{PEP} (only R&S MR300xH)	10 W_{PEP} ±1 dB
	5 W_{PEP}	5 W_{PEP} ±1 dB
	2 W_{PEP}	2 W_{PEP} ±2 dB
	1 W_{PEP}	1 W_{PEP} ±2 dB
	0.5 W_{PEP}	0.5 W_{PEP} ±3 dB
	Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10, only R&S MR300xH) and/or connected modules defective	
2.6	At the radio set output power to 10 W_{PEP} and set the following transmit frequencies in succession: Frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz and 107.9 MHz (R&S MR300xH) 108.1 MHz, 185.1 MHz, 310.1 MHz and 502.125 MHz (R&S MR300xU) By using the communication analyzer check the output power at X1. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10, only R&S MR300xH) and/or connected modules defective	10 W_{PEP} ±1 dB
2.7	At the radio set a transmit frequency of 30.1 MHz and set the following output powers in succession. By using the communication analyzer check the output power at X1. Output power:	
	5 W_{PEP}	5 W_{PEP} ±1 dB
	2 W_{PEP}	2 W_{PEP} ±2 dB
	1 W_{PEP}	1 W_{PEP} ±2 dB
	0.5 W_{PEP}	0.5 W ±3 dB_{PEP}
	Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) (only R&S MR300xH) and/or connected modules defective	
2.8	Disconnect AF generator of audio analyzer from X5.1 / X5.22.	
3.	Single Carrier Power in FM Mode	

No.	Activity / fault elimination		Nominal value
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	variable (see below)	
	Output power:	variable (see below)	
	Modulation:	F3E (without modulation signal)	
	Information displayed:	RF → FRONT	
3.2	At the radio set output power to 20 W and set the following transmit frequencies in succession: Frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz and 29.9 MHz (R&S MR300xH) 25.1 MHz, 42.1 MHz, 70.1 MHz and 107.9 MHz (R&S MR300xU) By using the communication analyzer check the output power at X1 for each frequency. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10, only R&S MR300xH) and/or connected modules defective		20 W ±1 dB (R&S MR300xH) 10 W ±1 dB (R&S MR300xU)
3.3	At the radio set a transmit frequency of 1.983 MHz (R&S MR300xH) or 25.1 MHz (R&S MR300xU) and set the following output powers in succession. By using the communication analyzer check the output power at X1. Output power:		
	10 W (only R&S MR300xH)		10 W ±1 dB
	5 W		5 W ±1 dB
	2 W		2 W ±2 dB
	1 W		1 W ±2 dB
	0.5 W		0.5 W ±3 dB
	Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) (only R&S MR300xH) and/or connected modules defective		
3.4	At the radio set output power to 10 W and set the following transmit frequencies in succession: Frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz and 107. Hz (R&S MR300xH) 108.1 MHz, 185.1 MHz, 310.1 MHz and 502.125 MHz (R&S MR300xU) By using the communication analyzer check the output power at X1. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) (only R&S MR300xH) and/or connected modules defective		10 W ±1 dB

No.	Activity / fault elimination		Nominal value
3.5	At the radio set a transmit frequency of 30.1 MHz (R&S MR300xH) or 108.1 MHz (R&S MR300xU) and set the following output powers in succession. By using the communication analyzer check the output power at X1. Output power:		
	5 W		5 W ±1 dB
	2 W		2 W ±2 dB
	1 W		1 W ±2 dB
	0.5 W		0.5 W ±3 dB
	Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) (only R&S MR300xH) and/or connected modules defective		
4.	RF Power in Bypass Mode		
4.1	At the radio change the following parameters:		
	Mode switch:	RX/TX	
	Submenu OPERATION:	BYPASS	
	Frequency:	502.125 MHz (R&S MR300xH)	
		1.983 MHz (R&S MR300xU)	
	Modulation:	F3E	
	Information displayed:	RF → REAR	
4.2	By using the communication analyzer at X1 check the output power. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3) and/or connected modules defective		+7 dBm +2 / -6.0 dB (R&S MR300xH) 0 dBm +2 / -4.5 dB (R&S MR300xU)
4.3	At the radio change the following parameter: Tx frequency: 1.983 MHz (R&S MR300xH) or 502.125 MHz (R&S MR300xU)		
4.4	By using the communication analyzer at X1 check the level of output power. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3) and/or connected modules defective		0 dBm +2 / -4 dB (R&S MR300xH) +7 dBm +2 / -7 dB (R&S MR300xU)
4.5	Switch off test equipment and disconnect radio from test setup.		
4.6	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.7 Power at Rear Connector X6.		

4.5.7 Power at Rear Connector X6

1. Carry out the test steps: Table 4.11

Table 4.11 Power at Rear Connector X6 - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	At X6.C2 (RF_INOUT) connect a load resistor of 50 Ω / 500 W.		
1.3	Switch on test equipment and radio.		
2.	Power at REAR Connector X6		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	10.1 MHz (R&S MR300xH)	
		502.125 MHz (R&S MR300xU)	
	Output power:	20 W (R&S MR300xH)	
		10 W (R&S MR300xU)	
	Modulation:	F3E	
	Information displayed:	RF → REAR	
2.2	By using the communication analyzer at X6.C2 check output power at the load resistor. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3), and/or connected modules defective		P_{out} = 20 W ±1 dB (R&S MR300xH) P_{out} = 10 W ±1 dB (R&S MR300xU)
2.3	Switch off test equipment and disconnect radio from test setup.		
2.4	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.8 Frequency Accuracy of Transmitter in Fix Frequency Mode.		

4.5.8 Frequency Accuracy of Transmitter in Fix Frequency Mode

1. Carry out the test steps: Table 4.12

Table 4.12 Frequency Accuracy of Transmitter in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	107.99 MHz (R&S MR300xH)	
		502.125 MHz (R&S MR300xU)	
	Modulation:	F3E (without modulation signal)	
2.	Frequency Accuracy		
2.1	By using the communication analyzer at X1 check the transmit frequency. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		R&S MR300xH: 107.99 MHz ±54 Hz R&S MR300xU: 502.125 MHz ±251 Hz
2.2	Switch off test equipment and disconnect radio from test setup.		
2.3	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.9 Harmonic Emission of Transmitter in Fix Frequency Mode.		

4.5.9 Harmonic Emission of Transmitter in Fix Frequency Mode

1. Carry out the test steps: Table 4.13

Table 4.13 Harmonic Emission of Transmitter in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	variable (see below)	
	Output power:	variable (see below)	
	Modulation:	F3E (without modulation signal)	
2.	Harmonic Emission		
2.1	Only R&S MR 300xH: At radio set an output power of 20 W and the following transmit frequencies in succession. By using the communication analyzer at X1 check the harmonic emission, referred to the selected transmit frequency. Frequencies: 1.983 MHz, 10.1 MHz and 20.1 MHz **Possible cause of fault:** Module power amplifier (A2), ATU HF (A10) and/or connected modules defective		≤ -40 dBc
2.2	At radio set an output power of 10 W and the following transmit frequencies in succession. By using the communication analyzer at X1 check the harmonic emission, referred to the selected transmit frequency. Frequencies (R&S MR 300xH):		
	30.1 MHz		≤ -50 dBc
	60.125 MHz, 90.1 MHz and 107.99 MHz		≤ -55 dBc
	Frequencies (R&S MR 300xU):		
	25.1 MHz, 42.1 MHz, 70.9 MHz, 108.1 MHz, 185.1 MHz, 310.1 MHz and 502.125 MHz		≤ -65 dBc
	Possible cause of fault: Module power amplifier (A2), ATU HF (A10) (only R&S MR 300xH) and/or connected modules defective		
2.3	Switch off test equipment and disconnect radio from test setup.		
2.4	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.10 Transmitter Noise in Fix Frequency Mode.		

4.5.10 Transmitter Noise in Fix Frequency Mode

1. Carry out the test steps: Table 4.14

Table 4.14 Transmitter Noise in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	variable (see below)	
	Output power:	variable (see below)	
	Modulation:	F3E (without modulation signal)	
2.	Transmitter Noise (VCO2 and VCO3)		
2.1	At radio set an output power of 10 W and a transmit frequency (for VCO2) of 42.5 MHz ±20%.		
2.2	By using the communication analyzer at X1 check the sideband noise at a spacing of ±10% from the transmit frequency. **Possible cause of fault:** Module RF unit (A3), power amplifier (A2) and/or connected modules defective		≤ -160 dBc / Hz
2.3	At radio set an output power of 10 W and a transmit frequency (for VCO3) of 70.0 MHz ±20%.		
2.4	By using the communication analyzer at X1 check the sideband noise at a spacing of ± 10% from the transmit frequency. **Possible cause of fault:** Module RF unit (A3), power amplifier (A2) and/or connected modules defective		≤ -160 dBc / Hz
3.	Transmitter Noise (VCO 1) (only R&S MR300xH)		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	21.4 MHz ±20%	
	Output power:	20 W_{PEP}	
	Modulation:	+J3E (1 kHz, -6 dBm, online)	

No.	Activity / fault elimination	Nominal value
3.2	By using the communication analyzer at X1 check the sideband noise at a spacing of ±125 kHz from the transmit frequency. **Possible cause of fault:** Module RF unit (A3), power amplifier (A2) and/or connected modules defective	≤ -130 dBc / Hz
3.3	By using the communication analyzer at X1 check the sideband noise at a spacing of ±2 MHz from the transmit frequency. **Possible cause of fault:** Module RF unit (A3), power amplifier (A2) and/or connected modules defective	≤ -140 dBc / Hz
3.4	Switch off test equipment and disconnect radio from test setup.	
3.5	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.11 Two-tone Intermodulation of Transmitter in Fix Frequency Mode.	

4.5.11 Two-tone Intermodulation of Transmitter in Fix Frequency Mode

1. Carry out the test steps: Table 4.15

Table 4.15 Two-tone Intermodulation of Transmitter in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Two-tone Intermodulation Distortion at Power Supply 24 VDC		
2.1	Set power supply to +24 VDC.		
2.2	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	variable (see below)	
	Output power:	variable (see below)	
	Modulation:	+J3E (upper sideband)	
2.3	At X5.1 (LINE_TX-) and X5.22 (LINE_TX+) connect AF generator of audio analyzer and feed in two signals simultaneously with the following parameters:		
	f_{audio1}:	1.0 kHz	
	f_{audio2}:	1.8 kHz	
	Signal level:	0 dBm into 600 Ω (R&S MR300xH)	
		-6 dBm into 600 Ω (R&S MR300xU)	
2.4	At X1 (ANT) connect power meter input of communication analyzer.		
2.5	At radio set an output power of 20 W (R&S MR300xH) or 10 W (R&S MR300xU) and the following transmit frequencies in succession: Frequencies (R&S MR300xH): 1.983 MHz, 10.1 MHz and 20.1 MHz Frequencies (R&S MR300xU): 25.1 MHz, 42.1 MHz, 70.9 MHz, 108.1 MHz, 185.1 MHz and 310.1 MHz 502.125 MHz By using the communication analyzer at X1 check the intermodulation distortion (relative to PEP) at each test frequency. It is necessary to measure intermodulation products IM3, IM5 and IM7 for each test frequency. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2) and/or connected modules defective		≤ -34 dB_{PEP} ≤ -36 dB_{PEP} ≤ -32 dB_{PEP} (valid for greatest intermodulation product (IM3, IM5, IM7)

No.	Activity / fault elimination		Nominal value
2.6	Only R&S MR300xH: At radio set an output power of 10 W and the following transmit frequencies in succession: Frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz and 107.9 MHz By using the communication analyzer at X1 check the intermodulation distortion (relative to PEP) at each test frequency. It is necessary to measure intermodulation products IM3, IM5 and IM7 for each test frequency. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2) and/or connected modules defective		≤ -34 dB_{PEP} (valid for greatest intermodulation product (IM3, IM5, IM7)
3.	Two-tone Intermodulation Distortion at Power Supply 20 VDC		
3.1	Set power supply to +20 VDC.		
3.2	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	10.1 MHz	
	Output power:	20 W (R&S MR300xH)	
		10 W (R&S MR300xU)	
	Modulation:	+J3E (upper sideband)	
3.3	By using the communication analyzer at X1 check the intermodulation distortion (relative to PEP) at each test frequency.		
	It is necessary to measure intermodulation products IM3, IM5 and IM7 for each test frequency.		≤ -32 dB_{PEP} (R&S MR300xH) ≤ -36 dB_{PEP} (R&S MR300xU) (valid for greatest intermodulation product (IM3, IM5, IM7)
	Possible cause of fault: Module radio controller (A1), power amplifier (A2) and/or connected modules defective		
3.4	Switch off test equipment and disconnect radio from test setup.		
3.5	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.12 VSWR Reduction of Transmitter in Fix Frequency Mode.		

4.5.12 VSWR Reduction of Transmitter in Fix Frequency Mode

1. Carry out the test steps: Table 4.16

Table 4.16 VSWR Reduction of Transmitter in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	At X1 (ANT) connect a load resistor of 50 Ω / 500 W.		
2.	VSWR Reduction, HF Range (only R&S MR300xH)		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	10.1 MHz	
	Output power:	20 W	
	Modulation:	+J3E, f_{audio} on line, -6 dBm	
	f_{audio1}:	1.0 kHz	
	f_{audio2}:	1.8 kHz	
2.2	By using the communication analyzer at X1 check output power and output current (nominal) at an output load of 50 Ω. **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		P_{out} = 20 W_{PEP} ± 1 p;dB I_{out} < 3.3 A
2.3	Disconnect load resistor from X1.		
2.4	By using the communication analyzer at X1 check output current (reduced current). **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		I_{red} < 2.5 A
3.	VSWR Reduction, HF Range (only R&S MR300xU)		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	50 MHz	
	Output power:	10 W	
	Modulation:	+F3E,	

No.	Activity / fault elimination		Nominal value
3.2	By using the communication analyzer at X1 check output power and output current (nominal) at an output load of 50 Ω. **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		P_{out} = 10 W_{PEP} ±1 dB I_{out} < 2.5 A
3.3	Disconnect load resistor from X1.		
3.4	By using the communication analyzer at X1 check output current (reduced current). **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		I_{red} < 1.35 A
4.	VSWR Reduction, VHF Range		
4.1	At X1 (ANT) connect a load resistor of 50 Ω / 500 W.		
4.2	At the radio set the following:		
	Frequency:	60.125 MHz (R&S MR300xH)	
		310 MHz (R&S MR300xU)	
	Output power:	10 W	
	Modulation:	F3E	
4.3	By using the communication analyzer at X1 check output power and output current (nominal) at an output load of 50 Ω. **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		P_{out} = 10 W ± 1 dB I_{out} < 2.5 A
4.4	Disconnect load resistor from X1.		
4.5	By using the communication analyzer at X1 check output current (reduced current). **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		I_{red} < 1.35 A
4.6	Switch off test equipment and disconnect radio from test setup.		
4.7	If no errors have been detected during the tests described in this chapter, continue troubleshooting.sect. 4.5.13 Sensitivity of Receiver in Fix Frequency Mode		

4.5.13 Sensitivity of Receiver in Fix Frequency Mode

1. Carry out the test steps: Table 4.17

Table 4.17 Sensitivity of Receiver in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	SSB Mode		
2.1	To check the (S+N)/N value connect the audio analyzer at X4.B (AUDIO_RX).		
2.2	Connect signal generator at X1 (ANT).		
2.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	variable (see below)	
	Bandwidth:	2.4 kHz	
	Modulation:	+J3E (upper sideband)	
	Preamplifier:	OFF	
2.4	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -104 dBm at 11.237 MHz. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz, 30.1 MHz, 60.125 MHz, 90.1 MHz, 107.9 MHz, 108.1 MHz, 185.1 MHz, 310.1 MHz, 502.125 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
2.5	At the radio change the following setting:		
	Preamplifier:	ON	

No.	Activity / fault elimination		Nominal value
2.6	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -115 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz, 30.1 MHz, 60.125 MHz, 90.1 MHz, 107.9 MHz, 108.1 MHz, 185.1 MHz, 310.1 MHz, 502.125 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
3.	FM Mode		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	variable (see below)	
	Modulation:	F3E	
	Frequency shift:	±2.5 kHz	
	Bandwidth:	12.5 kHz	
	Preamplifier:	OFF	
3.2	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -104 dBm at 301.225 MHz. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
3.3	At the radio change the following setting:		
	Preamplifier:	ON	
3.4	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -109 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 1.983 MHz, 10.1 MHz, 20.1 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD

No.	Activity / fault elimination		Nominal value
3.5	At the radio change the following settings:		
	Frequency shift:	±6.25 kHz	
	Bandwidth:	25 kHz	
	Preamplifier:	OFF	
3.6	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -104 dBm at 301.225 MHz. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz, 107.9 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
3.7	At the radio change the following setting:		
	Preamplifier:	ON	
3.8	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -115 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz, 107.9 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
3.9	At the radio change the following setting:		
	Preamplifier:	OFF	
3.10	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -104 dBm at 301.225 M Hz. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 108.1 MHz, 185.1 MHz, 310.1 MHz, 502.125 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 d B SINAD
3.11	At the radio change the following setting:		
	Preamplifier:	ON	

No.	Activity / fault elimination		Nominal value
3.12	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -112 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 108.1 MHz, 185.1 MHz, 310.1 MHz, 502.125 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
4.	A3E Mode		
4.1	Set the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	variable (see below)	
	Modulation:	A3E	
	BW:	6 kHz	
	Modulation depth:	70%	
	Preamplifier:	ON	
4.2	At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -110 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT). RX frequencies: 30.1 MHz, 60.125 MHz, 90.1 MHz, 107.9 MHz **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
4.3	Only R&S MR300xU: At both radio and signal generator set the following receive frequencies in succession (see below). At signal generator set RF level -109 dBm. By using the audio analyzer at X4.B check AF signal (S+N)/N (with audio (psophometric) weighting filter acc. to CCITT): RX frequencies: 185.1 MHz, 310.1 MHz, 502.125 MHz Possible cause of fault: Module radio controller (A1), RF unit (A3) and/or connected modules defective		> 10 dB SINAD
5.	FSK Mode		
5.1	Connect the input of the vector signal generator at X5.11 (232_RXD2).		

No.	Activity / fault elimination		Nominal value
5.2	Set the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	40.050 MHz	
	Modulation mode:	F1D	
	Preamplifier:	ON (R&S MR300xH)	
		OFF (R&S MR300xU)	
5.3	By using the signal generator at antenna terminal X1 (ANT) feed in a digital signal with the following parameters:		
	Frequency:	40.050 MHz	
	Modulation:	FM signal with binary data at 16 kbit/s	
	Bit error rate (BER):	≤1% (if adjustable)	
	Receive level:	-110 dBm	
5.4	By using the vector signal generator at X5.11 check the bit error rate. **NOTICE** **The measurement should take at least one minute to ensure stable and reproducible results.** **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		≤ 1%
5.5	At the radio change the following setting:		
	Frequency:	426.1 MHz	
5.6	At the signal generator change the following settings:		
	Frequency:	426.1 MHz	
	Receive level:	-107 dBm (R&S MR300xH)	
		-109 dBm (R&S MR300xU)	
	only R&S MR300xU:		
	Modulation:	FM signal with binary data at 16 kbit/s	
	Bit error rate (BER):	≤1% (if adjustable)	

No.	Activity / fault elimination	Nominal value
5.7	By using the vector signal generator at X5.11 check the bit error rate. **NOTICE** **The measurement should take at least one minute to ensure stable and reproducible results.** **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective	≤ 1%
5.8	Switch off test equipment and disconnect radio from test setup.	
5.9	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.14 Desensitization of Receiver in Fix Frequency Mode.	

4.5.14 Desensitization of Receiver in Fix Frequency Mode

1. Carry out the test steps: Table 4.18

Table 4.18 Desensitization of Receiver in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	To check the SINAD value connect audio analyzer at X4.B (AUDIO_RX).		
1.4	Connect signal generator at X1 (ANT).		
2.	Desensitization (HF VCO)		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	variable (see below)	
	Modulation:	+J3E	
	Audio frequency:	1 kHz	
	Preamplifier:	OFF	
	AGC:	OFF	
	MGC	70 dB	
	BW:	2.4 kHz	
2.2	At both radio and signal generator set a receive frequency of 10.1 MHz. At signal generator set RF level -80 dBm. Reduce the set MGC value (70 dB) until the RMS audio level is in the range of 4 to 6 dBm. By using the audio analyzer check the SINAD (without audio (psophometric) weighting filter). **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 28 dB
2.3	By using the signal generator feed in an additional CW signal at a frequency offset of ±30 kHz and a power of 15 mV EMF.		
2.4	By using the audio analyzer check the SINAD (without audio (psophometric) weighting filter). **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		≥ 20 dB
2.5	Switch off test equipment and disconnect radio from test setup.		
2.6	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.15 Frequency Response of Receiver in Fix Frequency Mode.		

4.5.15 Frequency Response of Receiver in Fix Frequency Mode

1. Carry out the test steps: Table 4.19

Table 4.19 Frequency Response of Receiver in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	SSB Mode		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Bandwidth:	2.4 kHz (default)	
	Modulation:	+J3E	
	AGC:	OFF	
	MGC:	38 dB	
	Volume:	maximum	
2.2	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_C:	30.1 MHz	
	Signal level:	-80 dBm	
	Signal tuning:	from (f_C 100 Hz) to (f_C 3000 Hz), step 100 Hz	
2.3	By using the audio analyzer at X5.2 (LINE_RX-) / X5.15 (LINE_RX+) check the AF output level referred to the selected frequency. Determine the ripple factor by calculating the difference between maximum and minimum. **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		< ±2.5 dB
3.	FM Mode Test: In-Band Ripple of Audio Frequency Response		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Modulation:	F3E	

No.	Activity / fault elimination		Nominal value
3.2	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_c:	30.1 MHz	
	R&S MR300xH: Signal level:	-47 dBm	
	R&S MR300xU: Signal voltage:	1 mV	
	Modulation:	FM	
	Frequency shift:	6.25 kHz	
3.3	Tune modulation signal and by using the audio analyzer at X4.B (AUDIO_RX) check the corresponding AF output level referred to the selected frequency. Determine the ripple factor by calculating the difference between maximum and minimum. Specified values:		
	300 Hz		< ±2.5 dB
	1000 Hz		< ±2.5 dB
	2700 Hz		< ±2.5 dB
	Possible cause of fault: Module RF unit (A3) and/or connected modules defective		
4.	FM Mode Test: Adjacent-Channel Rejection ACR (VHF Range)		
4.1	At antenna terminal X1 (ANT) connect the power combiner.		
4.2	To check the SINAD value connect audio analyzer at X4.B (AUDIO_RX).		
4.3	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Modulation:	F3E	
	Frequency shift:	6.25 kHz	
	Preamplifier:	OFF	
	CCITT filter:	ON	
4.4	By using the signal generator at input 1 of the power combiners feed in an RF signal with the following parameters:		
	Frequency:	30.1 MHz	
	Modulation:	FM	
	Receive input level RF1:	variable	

No.	Activity / fault elimination		Nominal value
4.5	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, vary receive input level RF1 until the value of 12 dB SINAD is reached. Make a note of the set receive input level RF1.		12 dB SINAD
4.6	By using the signal generator at input 2 of power combiner feed in an RF signal with the following parameters:		
	Frequency:	30.125 MHz	
	Modulation:	unmodulated	
	Receive input level RF2:	variable	
4.7	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, increase receive input level RF2 until the value is reduced to 6 dB SINAD. Make a note of set receive input level RF2.		6 dB SINAD
4.8	From the noted RF levels calculate the adjacent channel rejection (ACR) as follows: RF1 - RF2 = ACR **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 60 dB
4.9	At the radio change the following setting:		
	Frequency:	60.125 MHz	
4.10	By using the signal generator at input 1 of the power combiner feed in an RF signal with the following parameters:		
	Frequency:	60.125 MHz	
	Modulation:	FM	
	Receive input level RF1:	variable	
4.11	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, vary receive input level RF1 until the value of 12 dB SINAD is reached Make a note of the set receive input level RF1.		12 dB SINAD
4.12	By using the signal generator at input 2 of the power combiner feed in an RF signal with the following parameters:		
	Frequency:	60.150 MHz	
	Modulation:	unmodulated	
	Receive input level RF2:	variable	
4.13	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, increase receive input level RF2 until the value is reduced to 6 dB SINAD. Make a note of the set receive input level RF2.		6 dB SINAD

No.	Activity / fault elimination		Nominal value
4.14	From the noted RF levels calculate the adjacent channel rejection (ACR) as follows: RF1 - RF2 = ACR **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 60 dB
4.15	At the radio change the following setting: Frequency: 107.9 MHz		
4.16	By using the signal generator at input 1 of the power combiner feed in an RF signal with the following parameters:		
	Frequency:	107.9 MHz	
	Modulation:	FM	
	Receive input level RF1:	variable	
4.17	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, vary receive input level RF1 until the value of 12 dB SINAD is reached Make a note of the set receive input level RF1.		12 dB SINAD
4.18	By using the signal generator at input 2 of the power combiner feed in an RF signal with the following parameters:		
	Frequency:	107.925 MHz	
	Modulation:	unmodulated	
	Receive input level RF2:	variable	
4.19	By using the audio analyzer at X4.B check AF signal (S+N)/N (with weighting filter acc. to CCITT). If necessary, increase receive input level RF2 until the value is reduced to 6 dB SINAD. Make a note of the set receive input level RF2.		6 dB SINAD
4.20	From the noted RF levels calculate the adjacent channel rejection (ACR) as follows: RF1 - RF2 = ACR **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 60 dB
4.21	Switch off test equipment and disconnect radio from test setup.		
4.22	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.16 IF Recjection of Receiver in Fix Frequency Mode		

4.5.16 IF Recjection of Receiver in Fix Frequency Mode

1. Carry out the test steps: Table 4.20

Table 4.20 IF Recjection of Receiver in Fix Frequency Mode - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	Connect signal generator at X1 (ANT).		
1.4	Connect audio analyzer at X4.B (AUDIO_RX).		
2.	IF Rejection		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	variable (see below)	
	Modulation:	+J3E	
	Preamplifier:	OFF	
	AGC:	OFF	
	MGC:	15 dB (R&S MR300xH)	
		18 dB (R&S MR300xU)	
	Volume:	maximum	
2.2	By using the signal generator at X1 (ANT) of radio feed in an RF signal with the following parameters:		
	Frequency:	1.983 MHz, 5 MHz, 12 MHz and 29.5 MHz	
	Signal level:	-110 dBm	
2.3	By using the audio analyzer measure audio level Laudio and note.		
2.4	Change signal generator frequency to 70.455 MHz (= 1st IF). Increase IF level L_0 until audio level L_{audio} measured in step 2.2 is reached again. Note IF level L_0.		
2.5	Calculate IF rejection as follows: $IF_{rejection}$ = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		≥ 100 dB
2.6	By using the signal generator at X1 (ANT) of radio feed in an RF signal with the following parameters:		
	Frequency:	31 MHz, 63 MHz and 109 MHz	
	Signal level:	-110 dBm	

No.	Activity / fault elimination		Nominal value
2.7	By using the audio analyzer measure audio level L_{audio} and note.		
2.8	Change signal generator frequency to 140.455 MHz (= 1st IF). Increase IF level L_0 until audio level L_{audio} measured in step 2.6 is reached again. Note IF level L_0.		
2.9	Calculate IF rejection as follows: $IF_{rejection}$ = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		≥ 100 dB
2.10	By using the signal generator at X1 (ANT) of radio feed in an RF signal with the following parameters:		
	Frequency:	111 MHz, 143 MHz, 145 MHz and 224 MHz	
	Signal level:	-110 dBm	
2.11	By using the audio analyzer measure audio level L_{audio} and note.		
2.12	Change signal generator frequency to 172.955 MHz (= 1st IF). Increase IF level L_0 until audio level L_{audio} measured in step 2.10 is reached again. Note IF level L_0.		
2.13	Calculate IF rejection as follows: $IF_{rejection}$ = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		≥ 85 dB
2.14	By using the signal generator at X1 (ANT) of radio feed in an RF signal with the following parameters:		
	Frequency:	226 MHz, 236 MHz, 333 MHz, 436 MHz and 510 MHz	
	Signal level:	-110 dBm	
2.15	By using the audio analyzer measure audio level L_{audio} and note.		
2.16	Change signal generator frequency to 140.455 MHz (= 1st IF). Increase IF level L_0until audio level L_{audio} measured in step 2.14 is reached again. Note IF level L_0.		
2.17	Calculate IF rejection as follows: $IF_{rejection}$ = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		≥ 80 dB
2.18	Switch off test equipment and disconnect radio from test setup.		
2.19	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.17 Total Harmonic Distortion.		

4.5.17 Total Harmonic Distortion

1. Carry out the test steps: Table 4.21

Table 4.21 Total Harmonic Distortion - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Total Harmonic Distorsion (THD) of Audio Signal		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	10.1 MHz	
	Modulation:	+J3E	
	Preamp:	OFF	
	AGC	ON	
	BW:	2.4 kHz	
2.2	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_c:	10.1 MHz	
	Signal level:	-60 dBm	
	Modulation:	+J3E	
	Audio frequency:	1.0 kHz	
2.3	By using the audio analyzer at X5.2 (LINE_RX-) / X5.15 (LINE_RX+) check the THD. **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		< 5%
2.4	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	60.125 MHz	
	Modulation:	F3E	
	Preamp:	OFF	
	AGC	ON	
	BW:	25 kHz	

No.	Activity / fault elimination		Nominal value
2.5	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_c:	60.125 MHz	
	Signal level:	-60 dBm	
	Modulation:	F3E	
	Frequency shift:	6.25 kHz	
	Audio frequency:	1.0 kHz	
2.6	By using the audio analyzer at X4.B (AUDIO_RX) check the THD. **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		< 5%
2.7	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	185.1 MHz	
	Modulation:	A3E	
	Preamp:	OFF	
	AGC	ON	
	BW:	6 kHz	
2.8	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_c:	185.1 MHz	
	Signal level:	-60 dBm	
	Modulation:	A3E	
	Modulation depth:	70%	
	Audio frequency:	1.0 kHz	
2.9	By using the audio analyzer at X4.B (AUDIO_RX) check the THD. **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		< 5%
2.10	At the radio change the following setting: Frequency: 502.125 MHz		
2.11	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency f_c:	502.125 MHz	
	Signal level:	-60 dBm	
	Modulation:	A3E	
	Modulation depth:	70%	
	Audio frequency:	1.0 kHz	

No.	Activity / fault elimination	Nominal value
2.12	By using the audio analyzer at X4.B (AUDIO_RX) check the THD. **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective	< 5%
2.13	Switch off test equipment and disconnect radio from test setup.	
2.14	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.18 RSSI Squelch.	

4.5.18 RSSI Squelch

1. Carry out the test steps: Table 4.22

Table 4.22 RSSI Squelch - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
1.3	Connect signal generator at X1 (ANT).		
1.4	Connect audio analyzer at X4.F (SQL).		
2.	RSSI (Receive Signal Strength Indication) Squelch		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Modulation:	+J3E	
	RSSI squelch:	ON	
	RSSI level:	20 dB	
	Volume:	maximum	
2.2	Check if AF output is muted. **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		muted
2.3	By using the audio analyzer at X4.F (SQL) check the impedance. **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		high
2.4	By using the signal generator at X1 (ANT) feed in an RF signal with the following parameters:		
	Frequency:	30.1 MHz	
	Signal level:	23 dBµV	
2.5	Check if AF output is enabled. **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		enabled
2.6	Check if TX LED is lighted. **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective		green

No.	Activity / fault elimination	Nominal value
2.7	By using the audio analyzer at X4.F (SQL) and X5.3 (~PTT_OUT/SQL) check the impedance. **Possible cause of fault:** Module radio controller (A1), RF unit (A3) and/or connected modules defective	low (without Rx signal high impedance)
2.8	Switch off test equipment and disconnect radio from test setup.	
2.9	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.19 Miscellaneous Functions.	

4.5.19 Miscellaneous Functions

1. Carry out the test steps: Table 4.23

Table 4.23 Miscellaneous Functions - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Function "VM_BLOWER_ON"		
2.1	Switch off the power supply of the radio.		
2.2	By using the digital multimeter (voltmeter) check the polarity of signal VM_BLOWER_ON.		
2.3	Activate VM_DETECT at X6.S11 (rear connector).		
2.4	Switch on the power supply of the radio.		
2.5	By using the digital multimeter (voltmeter) check if the signal voltage at X6.S11 (VM_DETECT) rises within the first second after power-up. **Possible cause of fault:** Module radio controller (A1), Power Supply (A5) and/or connected modules defective		+3.3 VDC
3.	Function "SO"		
3.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Modulation:	F3E	
3.2	At X1 (ANT) feed in an RF signal with the following parameters:		
	Carrier frequency fc:	30.1 MHz	
	Signal level:	-70 dBm	
	Modulation:	F3E	
	Frequency shift:	6.25 kHz	
	Audio frequency:	1.0 kHz	
3.3	By using the audio analyzer between X4.B (AUDIO_RX) and X4.J (~AUDIO_RX) check the output power at an impedance of 600 Ω. **Possible cause of fault:** Module radio controller (A1) and/or connected modules defective		3 to 6 dBm

No.	Activity / fault elimination		Nominal value
3.4	Disconnect signal SO at X4.C from GND. **NOTICE** **This causes a shut-down of all audio amplifiers within the radio.**		
3.5	By using the audio analyzer between X4.B (AUDIO_RX) and X4.J (~AUDIO_RX) check the output power at an impedance of 600 Ω. **Possible cause of fault:** Module radio controller (A1) and/or connected modules defective		< -50 dBm
4.	Function "MIC_BIAS"		
4.1	Connect connector contact X4.C (SO) to X4.G (GND).		
4.2	Connect connector contact X4.H (MIC_BIAS) to X4.G (GND) via 1-kΩ resistor.		
4.3	By using the digital multimeter (voltmeter) check the voltage at X4.H (MIC_BIAS). **Possible cause of fault:** Module radio controller (A1) and/or connected modules defective		+5 V ±10%
5.	Function "SILENT_LA"		
5.1	Switch off the power supply of the radio.		
5.2	Activate VM_DETECT at X6.S11 (rear connector).		
5.3	Switch on the power supply of the radio.		
5.4	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency:	25.1 MHz	
	Modulation:	F3E	
	Bandwidth:	12.5 kHz (R&S MR300xH)	
		25 kHz (R&S MR300xU)	
	Output power (PWR):	10 W	
	Information on display:	FRONT → 50Ω	
5.5	Activate SILENT_LA at X6.S22 (rear connector).		
5.6	Activate ~PTT1 at X4.K (front connector).		
5.7	Check the PTT1 function. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective		is blocked

No.	Activity / fault elimination	Nominal value
5.8	By using the communication analyzer at X6.C2 check the output power at the load resistor. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective	P_{out} = 0 W
5.9	Check if TX LED is lighted. **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective	must not turn red
5.10	Switch off test equipment and disconnect radio from test setup.	
5.11	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.20 Antenna Tuning Unit.	

4.5.20 Antenna Tuning Unit

1. Carry out the test steps: Table 4.24

Table 4.24 Antenna Tuning Unit - Fault Detection

No.	Activity / fault elimination	Nominal value
1.	Preparations	
1.1	Arrange test setup sect. 4.2 Test Setup	
1.2	Switch on test equipment and radio.	
2.	Antenna Tuning Unit	
2.1	Connect 50-W-load-resistor to connector X1 (ANT).	
2.2	At the radio press softkey RNG (range) and then EDT (edit).	
2.3	At the radio enter a start and a stop frequency to define the range where the faulty ATU frequency is located.	
2.4	Confirm by pressing ENT.	
2.5	Press softkey LRN (learn). **NOTICE** **The ATU now starts learning the frequencies between start and stop frequency.**	
2.6	Enter the faulty ATU frequency.	
2.7	Set the radio transmit power to 20 W and activate transmit mode.	
2.8	On the LC display check the bargraph indicator. **Possible cause of fault:** Module ATU defective Possible display if ATU is defective: at VSWR >3 to 5: qualitative VSWR indication at VSWR >5: message "VSWR5EXCEED"	full scale indication
2.9	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.21 Spurious Emissions.	

4.5.21 Spurious Emissions

1. Carry out the test steps: Table 4.25

Table 4.25 Spurious Emissions - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Spurious Emissions (HF Range)		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	TX	
	Frequency (2 * f_c):	10.1 MHz (R&S MR300xH)	
		25.1 MHz (R&S MR300xU)	
	Modulation:	F3E, without modulation signal at audio line input X4.D (AUDIO_TX)	
	TX output power:	20 W (R&S MR300xH)	
		10 W (R&S MR300xU)	
2.2	By using the communication analyzer check the spurious emissions (non-harmonic) for f > 0.95 * f_c or f < 1.05 * f_c. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		≤ -40 dBc (R&S MR300xH) ≤ -70 dBc (R&S MR300xU)
2.3	At the radio change the following parameter:		
	Frequency (f_c):	60.125 MHz	
2.4	By using the communication analyzer check the spurious emissions (non-harmonic) for f < 0.95 * f_c or f > 1.05 * f_c. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		≤ -70 dBc (R&S MR300xH) ≤ -75 dBc (R&S MR300xU)
2.5	At the radio change the following parameter:		
	Frequency (2 * f_c):	29.9 MHz (R&S MR300xH)	
		107.9 MHz (R&S MR300xU)	
2.6	By using the communication analyzer check the spurious emissions (non-harmonic) for f > 0.95 * f_c or f < 1.05 * f_c. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		≤ -40 dBc (R&S MR300xH) ≤ -75 dBc (R&S MR300xU)

No.	Activity / fault elimination		Nominal value
2.7	By using the communication analyzer check the spurious emissions (non-harmonic) for f < 0.95 * f_c or f > 1.05 * f_c. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		≤ -70 dBc
3.	Spurious Emissions (VHF Range)		
3.1	At the radio change the following parameters:		
	Frequency (2 * f_c):	90.1 MHz (R&S MR300xH)	
		225.1 MHz (R&S MR300xU)	
	TX output power:	10 W	
3.2	By using the communication analyzer check the spurious emissions (non-harmonic) for f < 0.95 * f_c or f > 1.05 * f_c. **Possible cause of fault:** Module power amplifier (A2), RF unit (A3) and/or connected modules defective		≤ -75 dBc (R&S MR300xH) ≤ -70 dBc (R&S MR300xU)
3.3	Switch off test equipment and disconnect radio from test setup.		
3.4	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.22 Crossmodulation.		

4.5.22 Crossmodulation

1. Carry out the test steps: Table 4.26

Table 4.26 Crossmodulation - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Crossmodulation		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	1.983 MHz	
	Bandwidth:	6 kHz	
	Modulation:	A3E	
	Preamplifier:	OFF	
	AGC:	OFF	
	MGC:	74 dB	
2.2	Connect signal generator at X1 (ANT) and feed in RF signal with the following parameters:		
	Frequency:	1.983 MHz	
	Signal level:	1 mV EMF	
	Modulation:	A3E	
	Modulation depth:	60%	
2.3	Connect audio analyzer at X4.B (AUDIO_RX). At the audio analyzer set the following parameters: RMS selective Bandwidth = 100 Hz		
2.4	Reduce MGC until an audio output level of 6 to 8 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF signal level value L_0.		
2.5	At the signal generator switch off modulation.		
2.6	By using a second signal generator at X1 (ANT) feed in an interfering signal with the following parameters:		
	Signal level:	0 dBm	
	Frequency offset:	30 kHz	
	Modulation:	A3E	
	Modulation depth:	60%	

No.	Activity / fault elimination		Nominal value
2.7	The modulation transfer to the RF signal must be smaller than 10%. This corresponds to the audio voltage of L_0 / 10.		
2.8	Calculate the crossmodulation. **NOTICE** **Crossmodulation is defined as the absolute power level of the interfering signal.** **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		> 0 dBm
2.9	At the radio and the signal generator change the following parameters:		
	Frequency:	10.1 MHz	
	MGC (radio only):	74 dB	
	Modulation (radio only):	ON	
2.10	Repeat steps 2.4 to 2.7.		
2.11	Calculate the crossmodulation. **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		> 0 dBm
2.12	At the radio and the signal generator change the following parameters:		
	Frequency:	29.9 MHz	
	MGC (radio only):	74 dB	
	Modulation (radio only):	ON	
2.13	Repeat steps 2.4 to 2.7.		
2.14	Calculate the crossmodulation. **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		> 0 dBm
2.15	Switch off test equipment and disconnect radio from test setup.		
2.16	If no errors have been detected during the tests described in this chapter, continue troubleshootingsect. 4.5.23 Intemodulation Distortion.		

4.5.23 Intemodulation Distortion

1. Carry out the test steps: Table 4.27

Table 4.27 Intemodulation Distortion - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Intermodulation Distortion (HF Range)		
2.1	At the radio set the following:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency fnom.:	1.983 MHz	
	Modulation:	+J3E	
	Preamplifier:	OFF	
	AGC:	OFF	
	MGC:	18 dB	
2.2	At the antenna terminal X1 (ANT) connect the power combiner.		
2.3	By using the signal generator at input 1 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+30 kHz	
2.4	By using the signal generator at input 2 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+60 kHz	
2.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio} of the intermodulation distorsion product and note.		
2.6	Disconnect the two signal generators from the power combiner inputs and disconnect power combiner from radio.		
2.7	By using the signal generator at X1 (ANT) feed in an HF signal with the following parameters:		
	Frequency $f_{nom.}$:	1.983 MHz	
	Signal level L_0:	adjust acc. to step 2.8	
	Modulation:	+J3E	
2.8	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator so that the audio level L_{audio} once again reaches the value acc. to step 2.5. Make a note of the signal level L_0.		

No.	Activity / fault elimination		Nominal value
2.9	Calculate the intermodulation distorsion IP3 as follows: IP3 = 0.5 ($L_{interf.}$ - L_0) + $L_{interf.}$ = 0.5 (3 Linterf. - L_0) **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		IP3 > +13 dBm (for all frequencies < 5 MHz)
2.10	At the following frequencies fnom. repeat steps 2.1 to 2.9:		
	Frequency $f_{nom.}$:	10.1 MHz and 20.1 MHz	IP3 > +15 dB (for all frequencies from 5 to 25 MHz)
	Frequency $f_{nom.}$:	29.9 MHz	IP3 > +15 dB (for all frequencies > 25 MHz)
	Possible cause of fault: Module power amplifier (A2) and/or connected modules defective		
3.	Intermodulation Distortion (VHF Range)		
3.1	At the radio change the following parameter:		
	Frequency f_{nom}:	30.1 MHz	
3.2	At antenna terminal X1 (ANT) connect the power combiner.		
3.3	By using the signal generator at input 1 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+130 kHz	
3.4	By using the signal generator at input 2 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+260 kHz	
3.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio} of the intermodulation distorsion product and note.		
3.6	Disconnect the two signal generators from the power combiner inputs and disconnect power combiner from radio.		
3.7	By using the signal generator at X1 (ANT) feed in an RF signal with the following parameters:		
	Frequency $f_{nom.}$:	30.1 MHz	
	Signal level L_0:	adjust acc. to step 3.8	
	Modulation:	+J3E	
3.8	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator so that the audio level L_{audio} once again reaches the value acc. to step 3.5. Make a note of the signal level L_0.		

No.	Activity / fault elimination		Nominal value
3.9	Calculate the intermodulation distorstorsion IP3 as follows: IP3 = 0.5 ($L_{interf.}$ - L_0) + $L_{interf.}$ = 0.5 (3 Linterf. - L_0) **Possible cause of fault:** Module power amplifier (A2) and/or connected modules defective		IP3 ≥+12 dBm
3.10	At the following frequencies repeat steps 3.1 to 3.9:		
	$f_{nom.}$ = 60.125 MHz		IP3 ≥+12 dBm
	$f_{nom.}$ = 107.9 MHz		IP3 ≥+12 dBm
	$f_{nom.}$ = 90.1 MHz		IP3 ≥+12 dBm
	Possible cause of fault: Module power amplifier (A2) and/or connected modules defective		
3.11	Switch off test equipment and disconnect radio from test setup.		
4.	Only R&S MR300xU: Intermodulation Distortion (UHF Range)		
4.1	At the radio change the following parameter: Frequency $f_{nom.}$: 108.1 MHz		
4.2	At antenna terminal X1 (ANT) connect the power combiner.		
4.3	By using the signal generator at input 1 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+130 kHz	
4.4	By using the signal generator at input 2 of the power combiner feed in an interfering signal with the following parameters:		
	Input level $L_{interf.}$:	-10 dBm	
	Frequency offset:	+260 kHz	
4.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio} of the intermodulation distorsion product and note.		
4.6	Disconnect the two signal generators from the power combiner inputs and disconnect power combiner from radio.		
4.7	By using the signal generator at X1 (ANT) feed in an RF signal with the following parameters:		
	Frequency $f_{nom.}$:	108.1 MHz	
	Signal level L_0:	adjust acc. to step 4.8	
	Modulation:	+J3E	
4.8	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator so that the audio level L_{audio} once again reaches the value acc. to step 4.5. Make a note of the signal level L_0.		

No.	Activity / fault elimination	Nominal value
4.9	Calculate the intermodulation distorsion IP3 as follows:	
	IP3 = 0.5 ($L_{interf.}$ - L_0) + Linterf. = 0.5 (3 $L_{interf.}$ - L_0)	IP3 ≥ +12 dBm
	Possible cause of fault: Module power amplifier (A2) and/or connected modules defective	
4.10	A the following frequencies fnom. repeat steps 4.1 to 4.9:	
	$f_{nom.}$ = 185.1 MHz	IP3 ≥ +12 dBm
	$f_{nom.}$ = 310.1 MHz	IP3 ≥ +12 dBm
	$f_{nom.}$ = 502.125 MHz	IP3 ≥ +12 dBm
	Possible cause of fault: Module power amplifier (A2) and/or connected modules defective	
4.11	Switch off test equipment and disconnect radio from test setup.	
4.12	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.24 Weighted S/N Ratio.	

4.5.24 Weighted S/N Ratio

1. Carry out the test steps: Table 4.28

Table 4.28 Weighted S/N Ratio - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Weighted S/N Ratio		
2.1	Connect the audio analyzer at X4.B (AUDIO_RX).		
2.2	Connect signal generator at X1 (ANT).		
2.3	At the radio set the following parameters:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	30.1 MHz	
	Modulation:	+J3E	
	AGC:	ON	
2.4	At the signal generator set the following parameters:		
	Frequency:	30.101 MHz	
	Signal level:	1 mV EMF	
2.5	By using the audio analyzer at X4.B check SINAD (with audio (psophometric) weighting filter acc. to CCITT). **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 40 dB
2.6	Switch off test equipment and disconnect radio from test setup.		
2.7	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.25 Image Rejection.		

4.5.25 Image Rejection

1. Carry out the test steps: Table 4.29

Table 4.29 Image Rejection - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Image Rejection (HF Range)		
2.1	Connect the audio analyzer at X4.B (AUDIO_RX).		
2.2	Connect signal generator at X1 (ANT).		
2.3	At the radio set the following parameters:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency f_0:	1.983 MHz	
	Modulation:	+J3E	
	AGC:	OFF	
	Preamplifier:	OFF	
	MGC:	15 dB	
2.4	At the signal generator set the following parameters:		
	Frequency:	1.983 MHz	
	Signal level:	-110 dBm	
2.5	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the measured audio level.		
2.6	At the signal generator change the following parameter:		
	Frequency:	142.893 MHz (1^{st} IF)	
2.7	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 2.5. Make a note of the signal level L_0.		
2.8	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
2.9	At the radio change the following parameter:		
	Frequency f_0:	5 MHz	

No.	Activity / fault elimination		Nominal value
2.10	At the signal generator set the following parameters:		
	Frequency:	5 MHz	
	Signal level:	-110 dBm	
2.11	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level.		
2.12	At the signal generator change the following parameter:		
	Frequency:	145.910 MHz (1^{st} IF)	
2.13	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 2.11. Make a note of the signal level L_0.		
2.14	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
2.15	At the radio change the following parameter:		
	Frequency f_0:	12 MHz	
2.16	At the signal generator set the following parameters:		
	Frequency:	12 MHz	
	Signal level:	-110 dBm	
2.17	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level.		
2.18	At the signal generator change the following parameter:		
	Frequency:	152.910 MHz (1^{st} IF)	
2.19	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 2.17. Make a note of the signal level L_0.		
2.20	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
2.21	At the radio change the following parameter:		
	Frequency f_0:	29.5 MHz	
2.22	At the signal generator set the following parameters:		
	Frequency:	29.5 MHz	
	Signal level:	-110 dBm	
2.23	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		

No.	Activity / fault elimination		Nominal value
2.24	At the signal generator change the following parameter:		
	Frequency:	170.410 MHz (1st IF)	
2.25	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 2.23. Make a note of the signal level L_0.		
2.26	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
3.	Image Rejection (VHF Range)		
3.1	At the radio change the following parameter:		
	Frequency f_0:	31 MHz	
3.2	At the signal generator set the following parameters:		
	Frequency:	31 MHz	
	Signal level:	-110 dBm	
3.3	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.4	At the signal generator change the following parameter:		
	Frequency:	311.910 MHz (1st IF)	
3.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.3. Make a note of the signal level L_0.		
3.6	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
3.7	At the radio change the following parameter:		
	Frequency f_0:	63 MHz	
3.8	At the signal generator set the following parameters:		
	Frequency:	63 MHz	
	Signal level:	-110 dBm	
3.9	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.10	At the signal generator change the following parameter:		
	Frequency:	343.910 MHz (1st IF)	
3.11	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.9. Make a note of the signal level L_0.		

No.	Activity / fault elimination		Nominal value
3.12	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
3.13	At the radio change the following parameter:		
	Frequency f_0:	109 MHz	
3.14	At the signal generator set the following parameters:		
	Frequency:	109 MHz	
	Signal level:	-110 dBm	
3.15	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.16	At the signal generator change the following parameter:		
	Frequency:	389.910 MHz (1^{st} IF)	
3.17	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.15. Make a note of the signal level L_0.		
3.18	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
3.19	At the radio change the following parameter:		
	Frequency f_0:	109 MHz	
3.20	At the signal generator set the following parameters:		
	Frequency:	109 MHz	
	Signal level:	-110 dBm	
3.21	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.22	At the signal generator change the following parameter:		
	Frequency:	109.910 MHz (2nd IF)	
3.23	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.21. Make a note of the signal level L_0.		
3.24	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 70 dB
3.25	At the radio change the following parameter:		
	Frequency f_0:	111 MHz	

No.	Activity / fault elimination		Nominal value
3.26	At the signal generator set the following parameters:		
	Frequency:	111 MHz	
	Signal level:	-110 dBm	
3.27	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.28	At the signal generator change the following parameter:		
	Frequency:	111.910 MHz (2nd IF)	
3.29	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.27. Make a note of the signal level L_0.		
3.30	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 70 dB
3.31	At the radio change the following parameter:		
	Frequency f_0:	145 MHz	
3.32	At the signal generator set the following parameters:		
	Frequency:	145 MHz	
	Signal level:	-110 dBm	
3.33	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
3.34	At the signal generator change the following parameter:		
	Frequency:	145.910 MHz (2nd IF)	
3.35	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 3.33. Make a note of the signal level L_0.		
3.36	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 70 dB
4.	Image Rejection (UHF1 Range)		
4.1	At the radio change the following parameter:		
	Frequency f_0:	111 MHz	
4.2	At the signal generator set the following parameters:		
	Frequency:	111 MHz	
	Signal level:	-110 dBm	
4.3	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		

No.	Activity / fault elimination		Nominal value
4.4	At the signal generator change the following parameter:		
	Frequency:	456.910 MHz (1st IF)	
4.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 4.3. Make a note of the signal level L_0.		
4.6	Calculate the image rejection as follows: Image rejection = 110 dB + L0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
4.7	At the radio change the following parameter:		
	Frequency f_0:	143 MHz	
4.8	At the signal generator set the following parameters:		
	Frequency:	143 MHz	
	Signal level:	-110 dBm	
4.9	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
4.10	At the signal generator change the following parameter:		
	Frequency:	488.910 MHz (1st IF)	
4.11	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 4.9. Make a note of the signal level L_0.		
4.12	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
4.13	At the radio change the following parameter:		
	Frequency f_0:	224 MHz	
4.14	At the signal generator set the following parameters:		
	Frequency:	224 MHz	
	Signal level:	-110 dBm	
4.15	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
4.16	At the signal generator change the following parameter:		
	Frequency:	364.910 MHz (1st IF)	
4.17	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 4.15. Make a note of the signal level L_0.		

No.	Activity / fault elimination		Nominal value
4.18	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 100 dB
5.	Image Rejection (UHF2 Range)		
5.1	At the radio change the following parameter:		
	Frequency f_0:	226 MHz	
5.2	At the signal generator set the following parameters:		
	Frequency:	226 MHz	
	Signal level:	-110 dBm	
5.3	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
5.4	At the signal generator change the following parameter:		
	Frequency:	506.910 MHz (1^{st} IF)	
5.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 5.3. Make a note of the signal level L_0.		
5.6	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
5.7	At the radio change the following parameter:		
	Frequency f_0:	333 MHz	
5.8	At the signal generator set the following parameters:		
	Frequency:	333 MHz	
	Signal level:	-110 dBm	
5.9	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
5.10	At the signal generator change the following parameter:		
	Frequency:	613.910 MHz (1^{st} IF)	
5.11	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 5.9. Make a note of the signal level L_0.		
5.12	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB

No.	Activity / fault elimination		Nominal value
5.13	At the radio change the following parameter:		
	Frequency f_0:	436 MHz	
5.14	At the signal generator set the following parameters:		
	Frequency:	436 MHz	
	Signal level:	-110 dBm	
5.15	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
5.16	At the signal generator change the following parameter:		
	Frequency:	716.910 MHz (1^{st} IF)	
5.17	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 5.15. Make a note of the signal level L_0.		
5.18	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
5.19	At the radio change the following parameter:		
	Frequency f_0:	510 MHz	
5.20	At the signal generator set the following parameters:		
	Frequency:	510 MHz	
	Signal level:	-110 dBm	
5.21	By using the audio analyzer at X4.B check the audio level L_{audio}. Make a note of the audio level value.		
5.22	At the signal generator change the following parameter:		
	Frequency:	790.910 MHz (1^{st} IF)	
5.23	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio level L_{audio}. At the same time adjust the signal level L_0 at the signal generator until the audio level L_{audio} once again reaches the value acc. to step 5.21. Make a note of the signal level L_0.		
5.24	Calculate the image rejection as follows: Image rejection = 110 dB + L_0 **Possible cause of fault:** Module RF unit (A3) and/or connected modules defective		> 80 dB
5.25	Switch off test equipment and disconnect radio from test setup.		
5.26	If no errors have been detected during the tests described in this chapter, continue troubleshooting sect. 4.5.26 Blocking.		

4.5.26 Blocking

1. Carry out the test steps: Table 4.30

Table 4.30 Blocking - Fault Detection

No.	Activity / fault elimination		Nominal value
1.	Preparations		
1.1	Arrange test setup sect. 4.2 Test Setup		
1.2	Switch on test equipment and radio.		
2.	Blocking (HF Range)		
2.1	Connect the audio analyzer at X4.B (AUDIO_RX).		
2.2	Connect signal generator at X1 (ANT).		
2.3	At the radio set the following parameters:		
	Mode switch:	RX/TX	
	Preset switch:	MAN	
	Submenu OPERATION:	RX	
	Frequency:	20.1 MHz	
	Modulation:	+J3E	
	AGC:	OFF	
	Preamplifier:	OFF	
	MGC:	78 dB	
	Bandwidth:	2.4 kHz	
2.4	At the signal generator set the following parameters:		
	Frequency:	20.1 MHz	
	Signal level:	1 mV EMF	
2.5	Reduce the MGC value until an audio output level of +4 to +7 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF level $L_0 1$.		
2.6	By using a second signal generator at X1 (ANT) feed in a signal (blocking signal) with the following parameters:		
	Signal level:	+3 dBm	
	Frequency offset:	30 kHz	
2.7	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio output level L_{02} and calculate the level change as follows: $\Delta L = L_{01} - L_{02}$ **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective		$\Delta L < 3$ dB
3.	Blocking (VHF Range)		

No.	Activity / fault elimination		Nominal value
3.1	At the radio change the following parameter:		
	Frequency f_0:	60.125 MHz	
3.2	At the signal generator set the following parameters:		
	Frequency:	60.125 MHz	
	Signal level:	1 mV EMF	
3.3	Reduce the MGC value until an audio output level of +4 to +7 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF level L_{01}.		
3.4	By using a second signal generator at X1 (ANT) feed in a signal (blocking signal) with the following parameters:		
	Signal level:	+13 dBm	
	Frequency offset:	10% from f_0	
3.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio output level L_{02} and calculate the level change as follows: $\Delta L = L_{01} - L_{02}$ **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective		$\Delta L < 3$ dB
3.6	At the radio change the following parameter:		
	Frequency f_0:	107.9 MHz	
3.7	At the signal generator set the following parameters:		
	Frequency:	107.9 MHz	
	Signal level:	1 mV EMF	
3.8	Reduce the MGC value until an audio output level of +4 to +7 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF level L_{01}.		
3.9	By using a second signal generator at X1 (ANT) feed in a signal (blocking signal) with the following parameters:		
	Signal level:	+13 dBm	
	Frequency offset:	10% from f0	
3.10	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio output level L_{02} and calculate the level change as follows: $\Delta L = L_{01} - L_{02}$ **Possible cause of fault:** Module radio controller (A1), power amplifier (A2), RF unit (A3), ATU HF (A10) and/or connected modules defective		$\Delta L < 3$ dB
4.	Only R&S MR300xU: Blocking (UHF Range)		
4.1	At the radio change the following parameter:		
	Frequency f_0:	135.1 MHz	

No.	Activity / fault elimination		Nominal value
4.2	At the signal generator set the following parameters:		
	Frequency:	135.1 MHz	
	Signal level:	1 mV EMF	
4.3	Reduce the MGC value until an audio output level of +4 to +7 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF level L_{01}.		
4.4	By using a second signal generator at X1 (ANT) feed in a signal (blocking signal) with the following parameters:		
	Signal level:	+13 dBm	
	Frequency offset:	10% from f_0	
4.5	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio output level L_{02} and calculate the level change as follows: $\Delta L = L_{01} - L_{02}$ Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3) and/or connected modules defective		$\Delta L < 3$ dB
4.6	At the radio change the following parameter:		
	Frequency f_0:	200.1 MHz	
4.7	At the signal generator set the following parameters:		
	Frequency:	200.1 MHz	
	Signal level:	1 mV EMF	
4.8	Reduce the MGC value until an audio output level of +4 to +7 dBm is measured at X4.B (AUDIO_RX) by using the audio analyzer. Make a note of the measured AF level L_{01}.		
4.9	By using a second signal generator at X1 (ANT) feed in a signal (blocking signal) with the following parameters:		
	Signal level:	+13 dBm	
	Frequency offset:	10% from f_0	
4.10	By using the audio analyzer at X4.B (AUDIO_RX) measure the audio output level L_{02} and calculate the level change as follows: $\Delta L = L_{01} - L_{02}$ Possible cause of fault: Module radio controller (A1), power amplifier (A2), RF unit (A3) and/or connected modules defective		$\Delta L < 3$ dB
4.11	Switch off test equipment and disconnect radio from test setup.		
4.12	If no errors have been detected during the tests described in this chapter, troubleshooting can be regarded as completed. For more detailed troubleshooting please contact Rohde & Schwarz service personnel.		

5 Replacement of Modules

5.1 Disassemble Procedures

1.

NOTICE

In this chapter mod. 02/03 is illustrated.

For mod. 04 the line interface is not present.

NOTICE

If the covers are labeled (upper and lower cover), the assembly positions of the covers must be observed. Covers without labels can be interchanged.

NOTICE

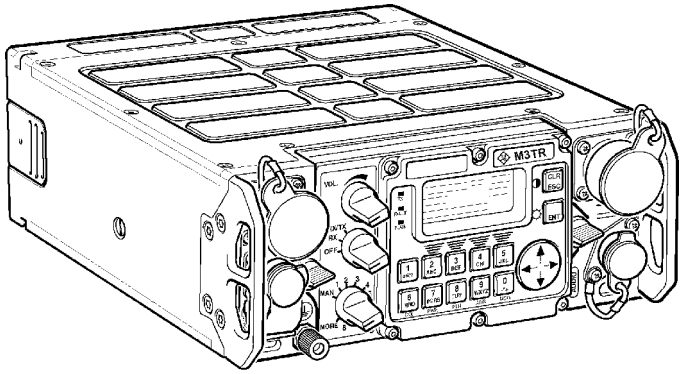
The tactical radio may be opened only by authorized, specially trained personnel.

NOTICE

If the tactical radio is a manpack, first of all remove the battery pack before opening the unit.

Put the tactical radio on a work table in operating position (Figure 5.1).

Figure 5.1 Operating Position



ICN-4G-A-231000-R-D0894-20003-A-01-1

2 Undo the nine captive hexagon socket head screws at the upper cover by using a socket head screw key (2.5 mm).

3

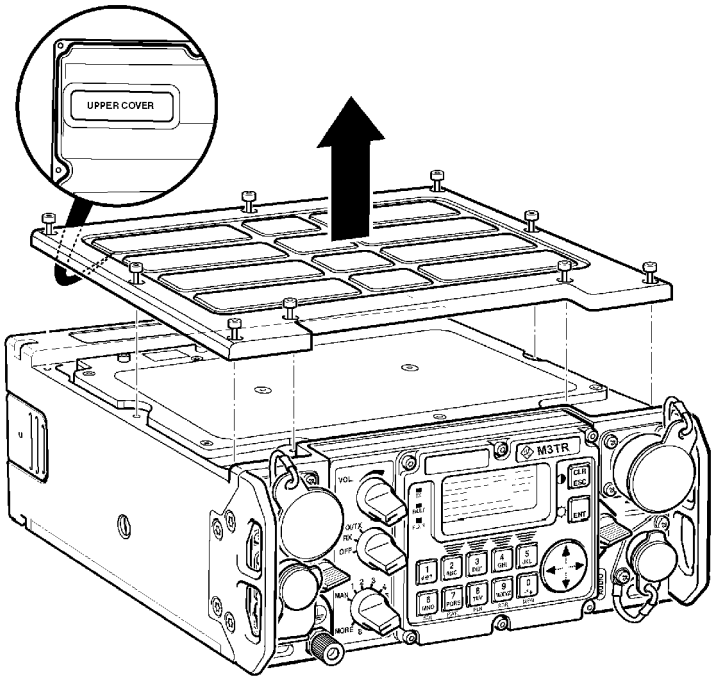
CAUTION

Turn the covers upside down before putting them on the work table.

The RF gaskets on the covers must not get in contact with paper, as the sulphur in the paper will damage the gaskets.

Lift the upper cover carefully off (Figure 5.2).

Figure 5.2 Removing the Upper Cover



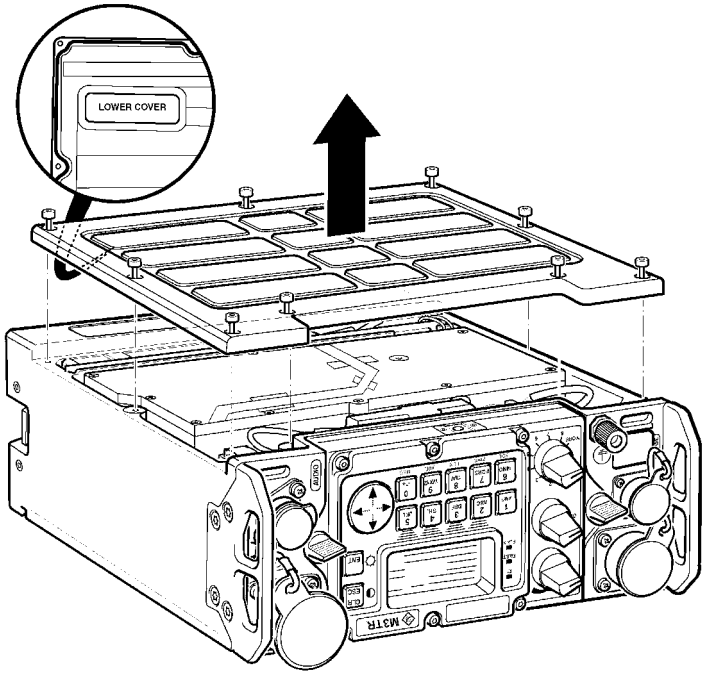
ICN-4G-A-231000-R-D0894-20004-A-01-1

4 Turn the tactical radio upside down and put it on the work table, the lower cover should now be accessible (Figure 5.3).

5 Undo the nine captive socket head screws at the lower cover by using a socket head screw key.

6 Lift the lower cover carefully off (Figure 5.3).

Figure 5.3 Removing the Lower Cover



ICN-4G-A-231000-R-D0894-20005-A-01-1

5.2 Replacing Individual Modules

Replace individual modules according to:

Radio Controller	sect. 5.2.1 Radio Controller - Change
Radio Frequency Unit	sect. 5.2.2 RF Unit - Change
Antenna Tuning Unit	sect. 5.2.3 Antenna Tuning Unit - Change
HF/VHF Power Amplifier	sect. 5.2.4 HF/VHF Power Amplifier - Change
VHF/UHF Power Amplifier	sect. 5.2.5 VHF/UHF Power Amplifier - Change
Power Supply	sect. 5.2.6 Power Supply - Change
Front Panel	sect. 5.2.7 Front Panel - Change
Battery	sect. 5.2.8 Radio Controller - Battery - Change
Sealing Cords	sect. 5.2.9 Housing - Sealing Cords - Change

5.2.1 Radio Controller - Change

1. Removing the Radio Controller:

a. Put the tactical radio upside down on a work table so that the lower cover is accessible from the top (Figure 5.4).

b. Remove the lower cover.

⚠ CAUTION

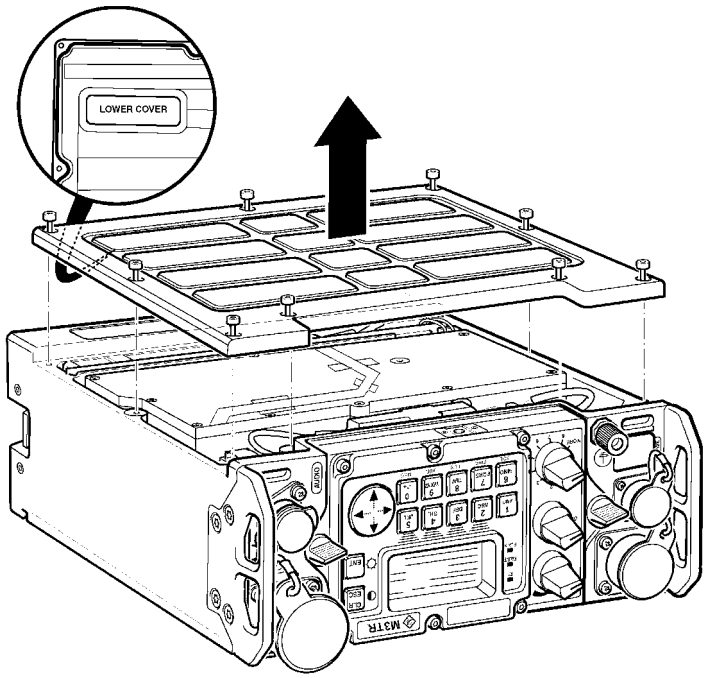
Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

1. Undo the nine captive hexagon socket head screws at the lower cover by using a socket head screw key (2.5 mm).

2. Lift the lower cover carefully off.

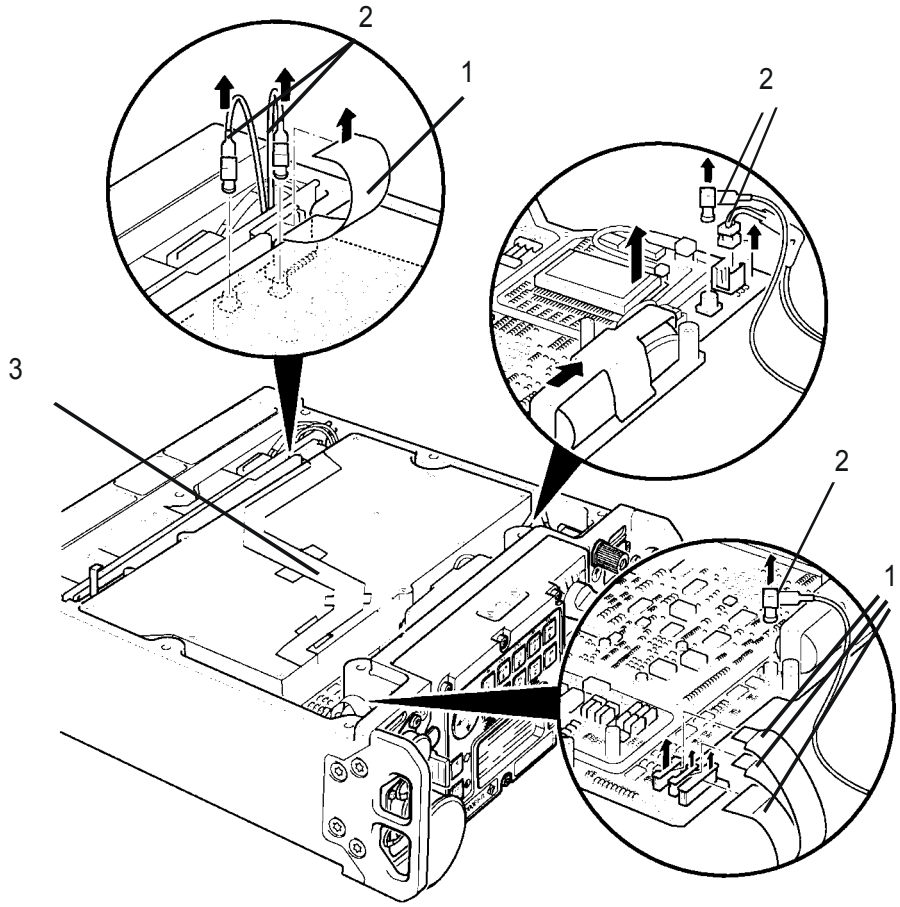
Figure 5.4 Removing the Lower Cover



ICN-4G-A-231000-R-D0894-20005-A-01-1

c. Disconnect the Line Interface A6 (, only mod. 02/03).

Figure 5.5 Radio Controller, Undoing Cables



ICN-4G-A-231000-R-D0894-10007-A-01-1

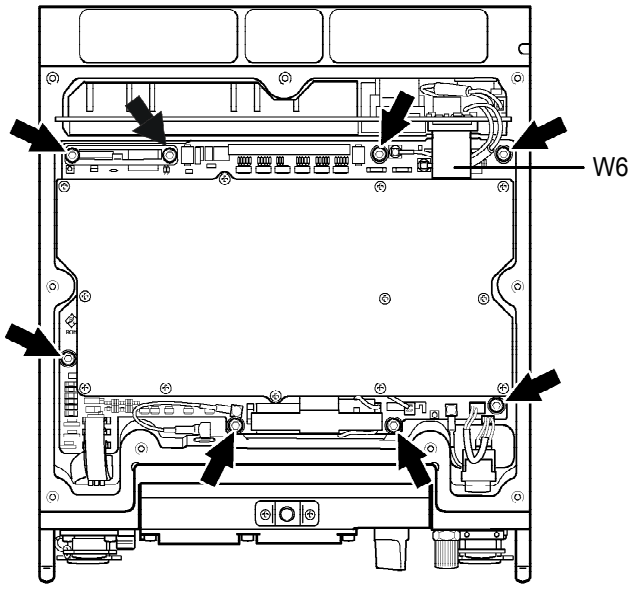
1 Connectors
2 RF cables
3 Line Interface

d. Undo the four ribbon cables on the Radio Controller PCB. To do so first of all undo the securing clips at the connectors. Then pull off connectors carefully ().

e. Undo all RF cables and other connectors on the Radio Controller PCB carefully by using an extracting hook ().

f. Undo the eight hexagon head screws fixing the Radio Controller in the housing of the tactical radio (Figure 5.6).

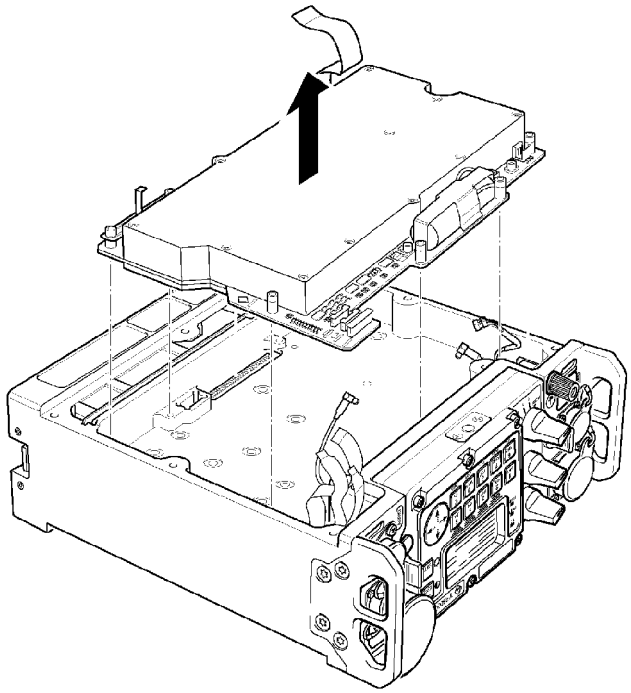
Figure 5.6 Radio Controller, Undoing Screws



ICN-4G-A-231000-R-D0894-10008-A-01-1

g. Lift the Radio Controller vertically out (Figure 5.7). The connection to the power amplifier connector will come undone automatically.

Figure 5.7 Radio Controller, Removal (only mod. 02/03)



ICN-4G-A-231000-R-D0894-10009-A-01-1

2 Installing the Radio Controller:

To install a new or repaired radio controller proceed in the reverse order of removal.

5.2.2 RF Unit - Change

1. Removing the RF Unit:

a. Put the tactical radio on a work table in operating position so that the upper cover is accessible from the top (Figure 5.8).

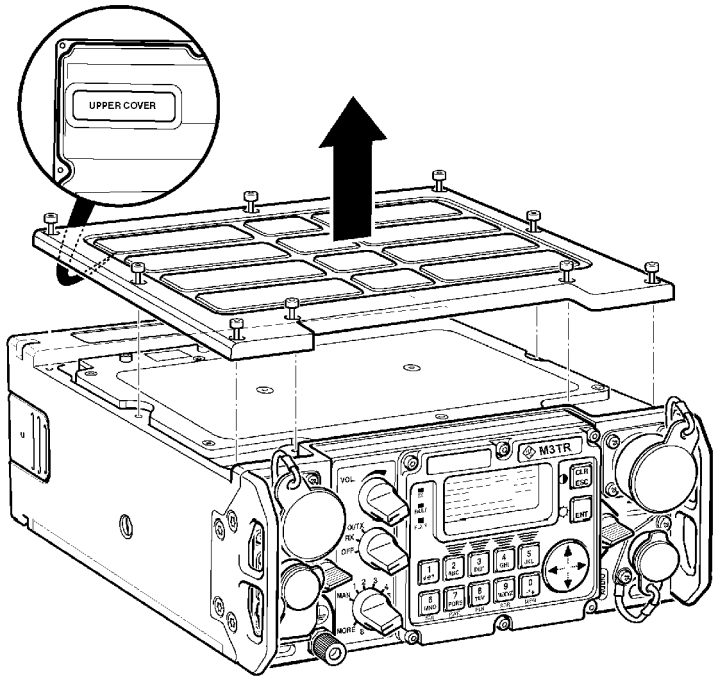
b. Remove the upper cover.

CAUTION

Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

Figure 5.8 Removing the Upper Cover



ICN-4G-A-231000-R-D0894-20004-A-01-1

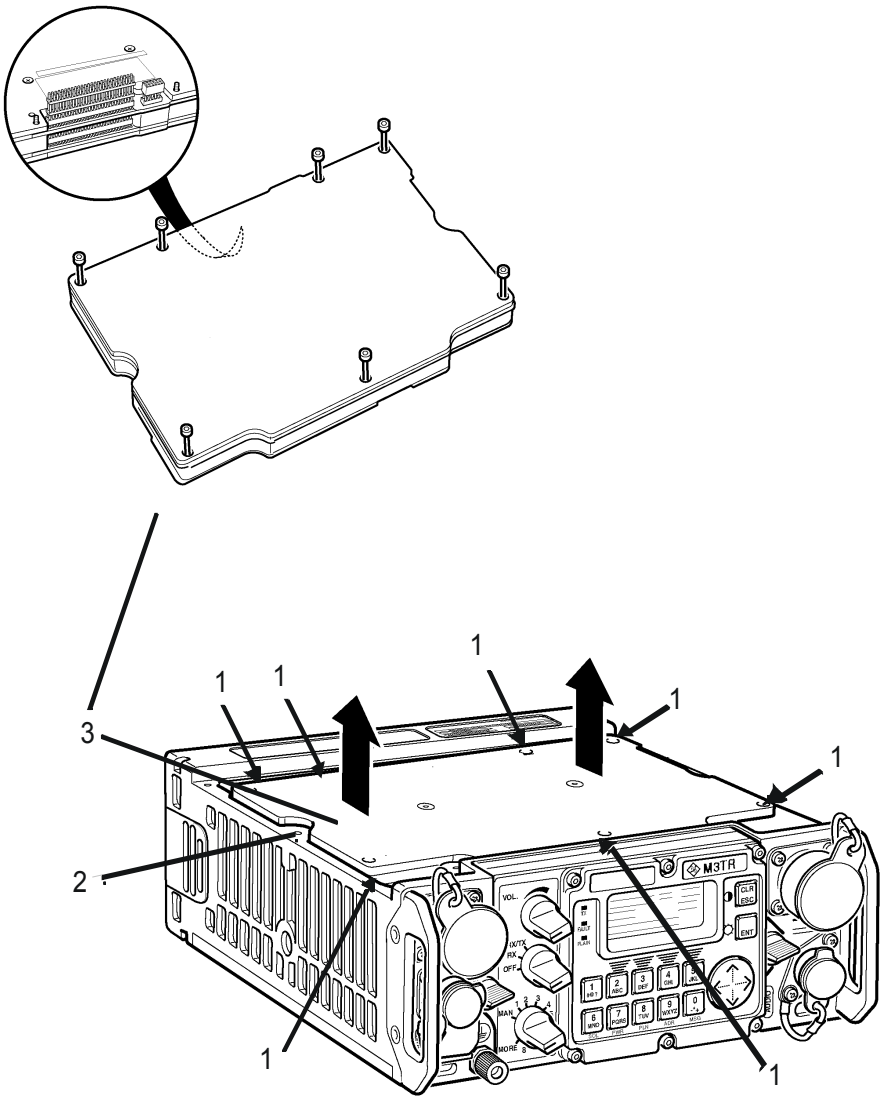
i. Undo the nine captive hexagon socket head screws at the upper cover by using a socket head screw key (2.5 mm).

ii. Lift the upper cover carefully off.

c. Undo the seven captive hexagon head screws () fixing the RF unit to the housing of the tactical radio.

d. Insert the extracting hook into the hole on the right provided for the purpose and with your left hand get hold of the RF unit () to lift it off carefully ().

Figure 5.9 RF Unit, Removal



ICN-4G-A-231000-R-D0894-10010-A-01-1

1 hexagon head screws
2 RF unit
3 RF unit removed

e. Undo RF cable W7 on the RF unit.

2 Installing the RF Unit:

To install a new or repaired RF unit proceed in the reverse order of removal.

5.2.3 Antenna Tuning Unit - Change

1.

NOTICE

Removal and installation of an ATU 3 and an ATU 4 are alike. If an ATU 4 is inserted instead of an ATU 3, a software update may be necessary.

Removing the Antenna Tuning from R&S MR 300xH:

a. Put the tactical radio on a work table in operating position so that the upper cover is accessible from the top (Figure 5.10).

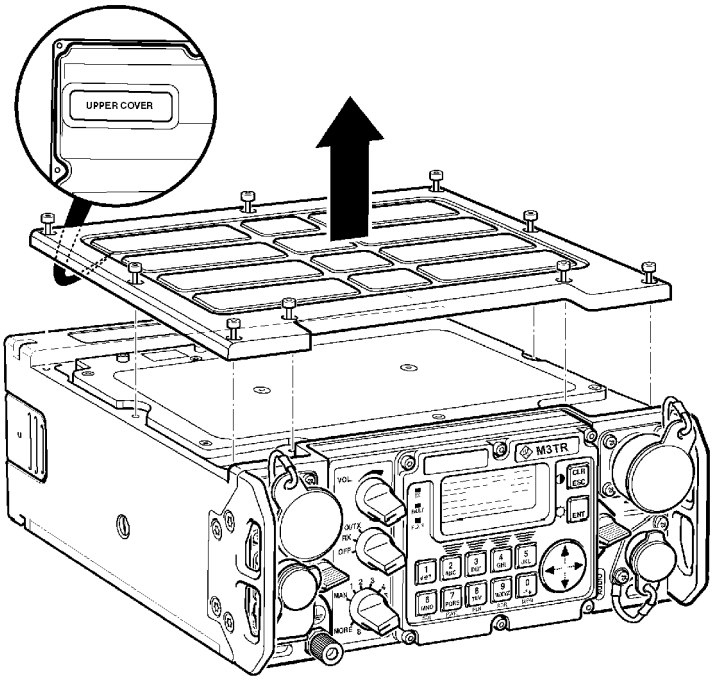
b. Remove the upper cover.

⚠ CAUTION

Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

Figure 5.10 R&S MR 300xH Removing the Upper Cover



ICN-4G-A-231000-R-D0894-20004-A-01-1

1. Undo the nine captive hexagon socket head screws at the upper cover by using a socket head screw key (2.5 mm).

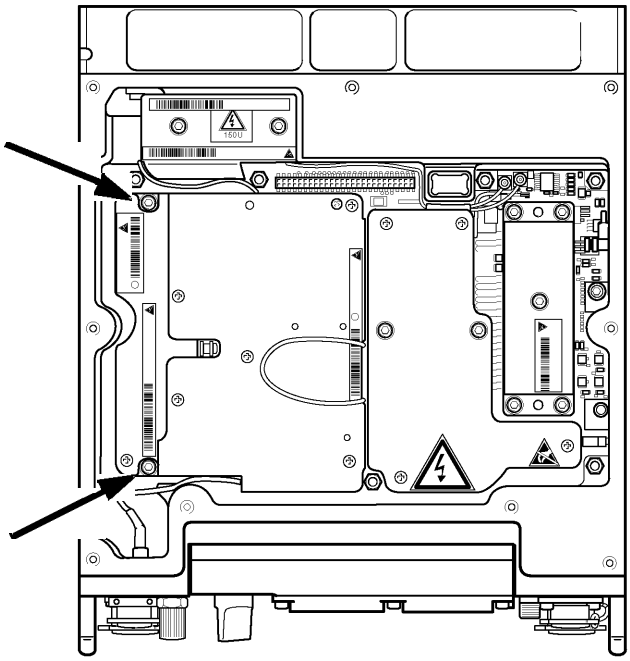
2. Lift the upper cover carefully off.

c. Remove the Radio Frequency Unit according to sect. 5.2.2 RF Unit - Change.

d. Remove Intermediate Plate.

e. Undo the two screws at the Antenna Tuning Unit (Figure 5.11) fixing it within the R&S MR 300xH.

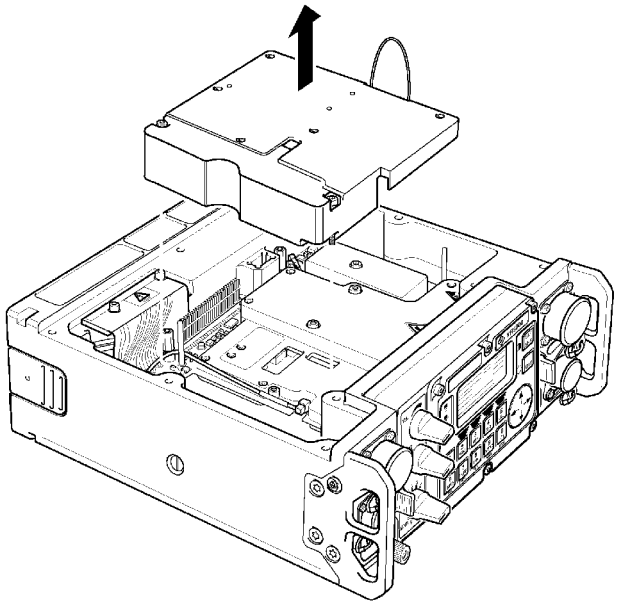
Figure 5.11 Antenna Tuning Unit, Undoing Screws



ICN-4G-A-231000-R-D0894-20007-A-01-1

f. Get hold of the strap and pull the Antenna Tuning Unit carefully out to the top (Figure 5.12).

Figure 5.12 Antenna Tuning Unit, Removal



ICN-4G-A-231000-R-D0894-20008-A-01-1

2 Installing the Antenna Tuning Unit:

To install a new or repaired Antenna Tuning Unit unit proceed in the reverse order of removal.

5.2.4 HF/VHF Power Amplifier - Change

1. Removing the HF/VHF Power Amplifier from R&S MR300xH:

a. Put R&S MR300xH on a work table in operating position so that the upper cover is accessible from the top (Figure 5.13).

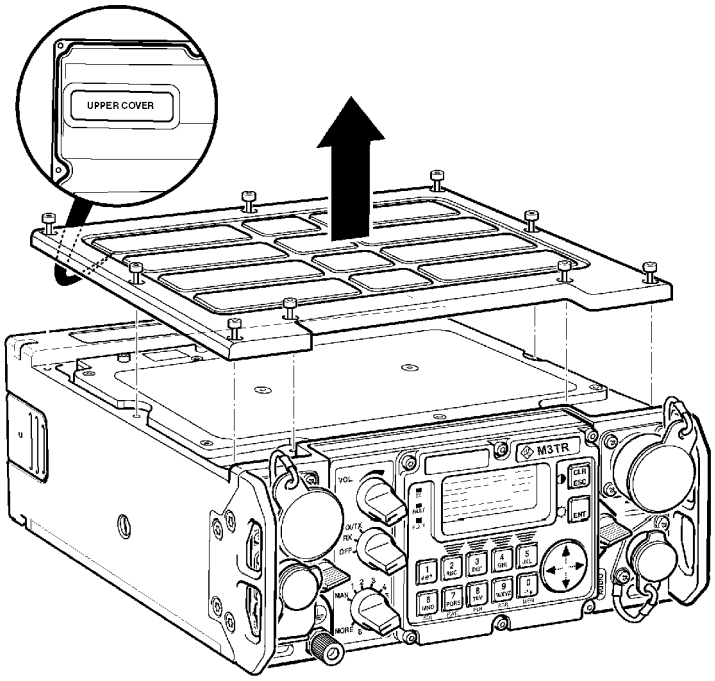
b. Remove the upper cover.

CAUTION

Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

Figure 5.13 R&S MR300xH, Removing the Upper Cover



ICN-4G-A-231000-R-D0894-20004-A-01-1

•Undo the nine captive hexagon socket head screws at the upper cover by using a socket head screw key (2.5 mm).

•Lift the upper cover carefully off.

c. Remove the Radio Frequency Unit according to sect. 5.2.2 RF Unit - Change.

d. Remove Intermediate Plates.

e. Remove the Antenna Tuning Unit according to sect. 5.2.3 Antenna Tuning Unit - Change.

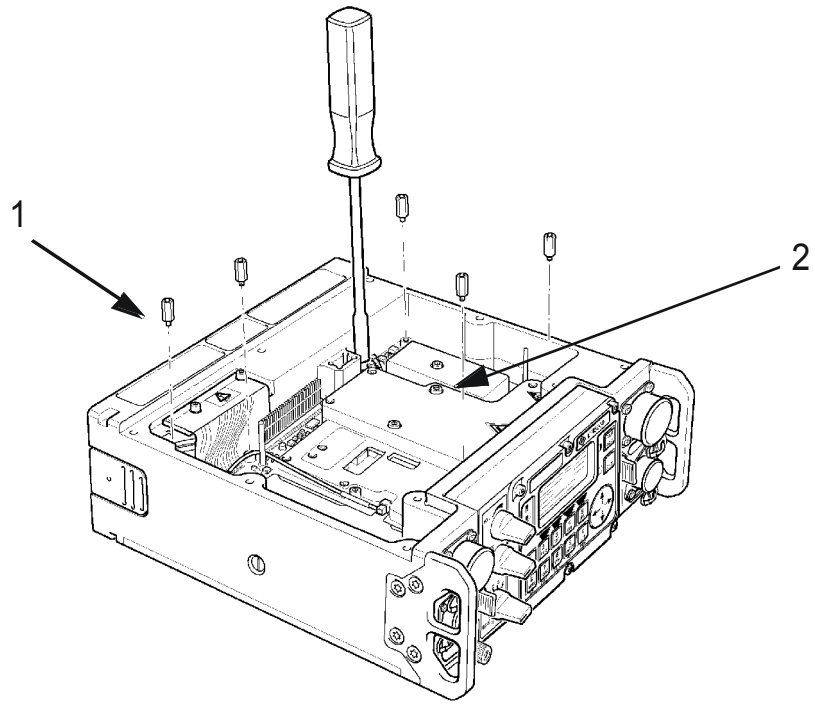
WARNING

The hybrid circuit () has been coated with toxic heat-conducting paste and therefore must not be touched without protection. Should the necessity arise to touch the hybrid circuit e.g. in repairs, be absolutely sure to wear rubber gloves. After use dispose of the gloves in accordance with the relevant waste disposal regulations. If in spite of all care you have got contaminated in any way, wash the toxic material off immediately with soap and plenty of water.

BERYLLIUM!

Some electronic power elements may have insulation made from beryllium oxide ceramics. Such components are especially marked on the circuit documentation. Please see the safety instructions for handling parts made from beryllium oxide ceramics.

Figure 5.14 Power Amplifier, Undoing Screws



ICN-4G-A-231000-R-D0894-20009-A-01-1

1 hexagon spacer bolts
2 hybrid circuit

f. At the power amplifier of R&S MR300xH undo the five hexagon spacer bolts () by using a socket wrench.

g.

CAUTION

Avoid any tensile or compressive stress on hybrid circuit and cables.

Pull off the RF cables () by using an extracting hook.

NOTICE

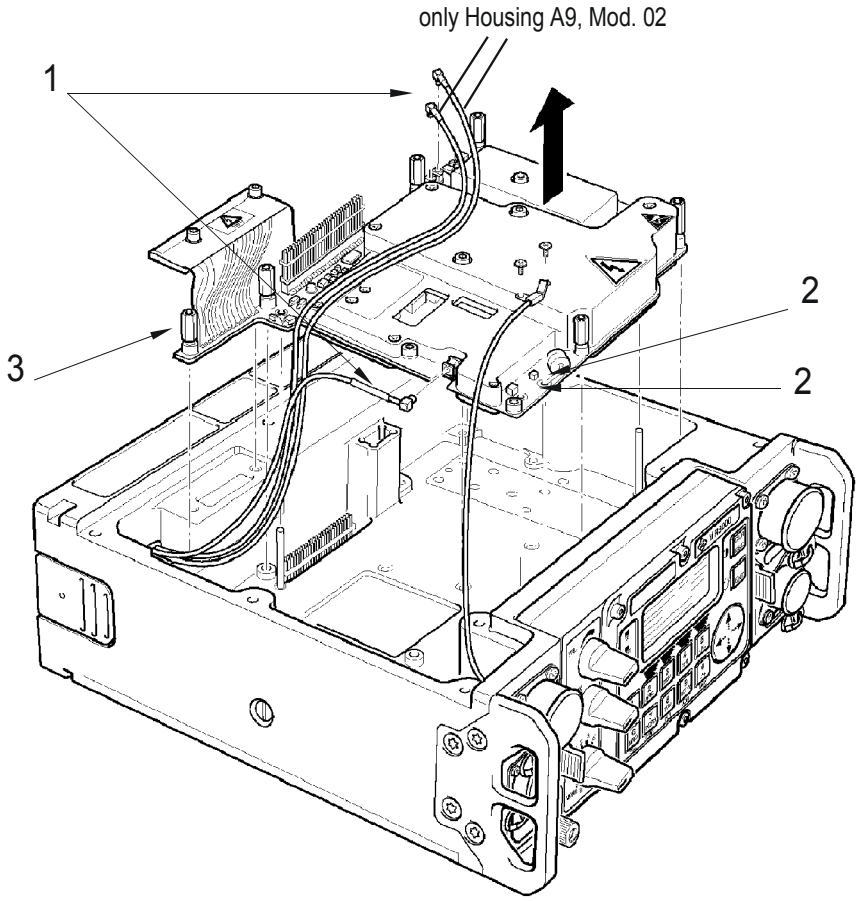
The lines with connectors X28 and X29 are only available with Mod. 02 of Housing A9.

h. Undo the two screws () fixing the cable eye at the power amplifier board.

i. Undo the two hexagon socket head screws () at the flexible wiring.

j. Lift the power amplifier carefully out.

Figure 5.15 Power Amplifier, Removal



ICN-4G-A-231000-R-D0894-20010-A-01-1

1 RF cables
2 Screws
3 Hexagon socket head screws

2 Installing the HF/VHF Power Amplifier in R&S MR300xH:

To install a new or repaired power amplifier proceed in the reverse order of removal.

5.2.5 VHF/UHF Power Amplifier - Change

1. Removing the VHF/UHF Power Amplifier from R&S MR300xU:

a. Put R&S MR300xU on a work table in operating position so that the upper cover is accessible from the top (Figure 5.16).

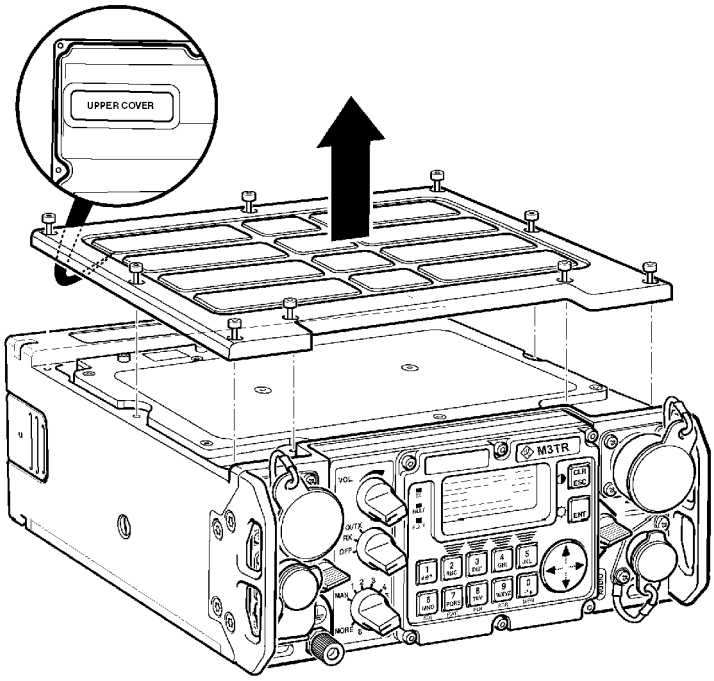
b. Remove the upper cover.

CAUTION

Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

Figure 5.16 R&S MR300xU, Removing the Upper Cover



ICN-4G-A-231000-R-D0894-20004-A-01-1

•Undo the nine captive hexagon socket head screws at the upper cover by using a socket head screw key (2.5 mm).

•Lift the upper cover carefully off.

c. Remove the RF unit (sect. 5.2.2 RF Unit - Change).

d. Remove the Intermediate Plates.

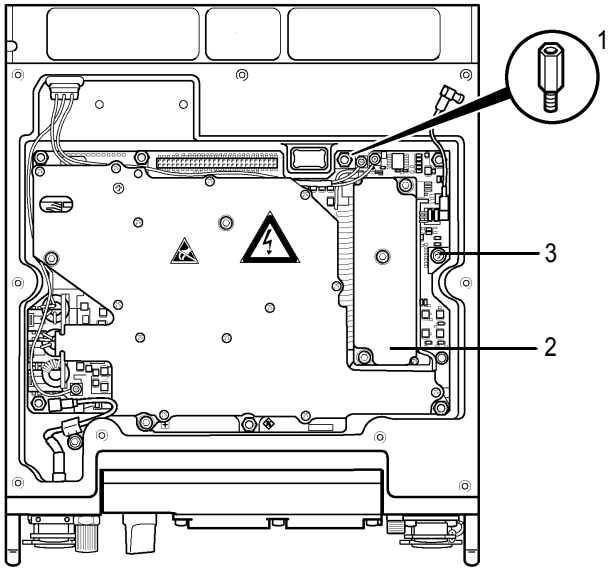
WARNING

The hybrid circuit () has been coated with toxic heat-conducting paste and therefore must not be touched without protection. Should the necessity arise to touch the hybrid circuit e.g. in repairs, be absolutely sure to wear rubber gloves. After use dispose of the gloves in accordance with the relevant waste disposal regulations. If in spite of all care you have got contaminated in any way, wash the toxic material off immediately with soap and plenty of water.

BERYLLIUM!

Some electronic power elements may have insulation made from beryllium oxide ceramics. Such components are especially marked on the circuit documentation. Please see the safety instructions for handling parts made from beryllium oxide ceramics.

Figure 5.17 Power Amplifier, Undoing Screws



ICN-4G-A-231000-R-D0894-10005-A-01-1

1 hexagon spacer bolts
2 hybrid circuit
3 screws

e. At the power amplifier undo the following screws:

- the seven hexagon spacer bolts () and
- the seven srews () by using a socket wrench.

f.

CAUTION

Avoid any tensile or compressive stress on hybrid circuit and cables.

Pull off the RF cables by using an extracting hook.

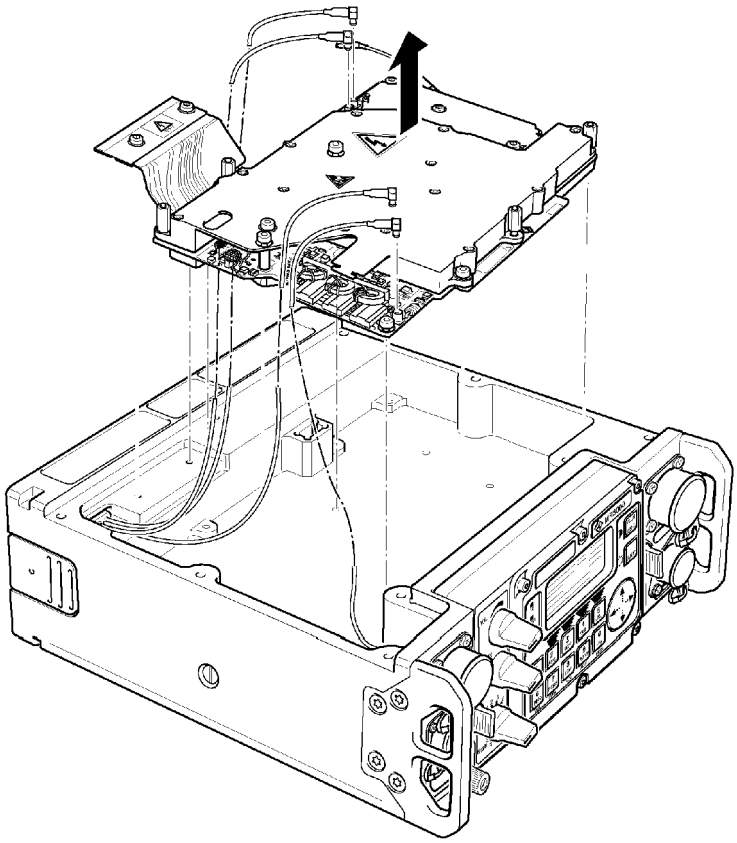
NOTICE

The lines with connectors X28 and X29 are only available with Mod. 02 of Housing A9.

g. Undo the two hexagon socket head screws at the flexible wiring.

h. Lift the power amplifier carefully out.

Figure 5.18 Power Amplifier, Removal



ICN-4G-A-231000-R-D0894-10006-A-01-1

2 Installing the VHF/UHF Power Amplifier in R&S MR300xU:

To install a new or repaired power amplifier proceed in the reverse order of removal.

5.2.6 Power Supply - Change

1.

NOTICE

Removal and installation of module Power Supply and module Power Supply II are alike. If a Power Supply II is inserted instead of module Power Supply, a software update may be necessary.

Removing the Power Supply:

a. Put the tactical radio upside down on a work table so that the lower cover is accessible from the top (Figure 5.19).

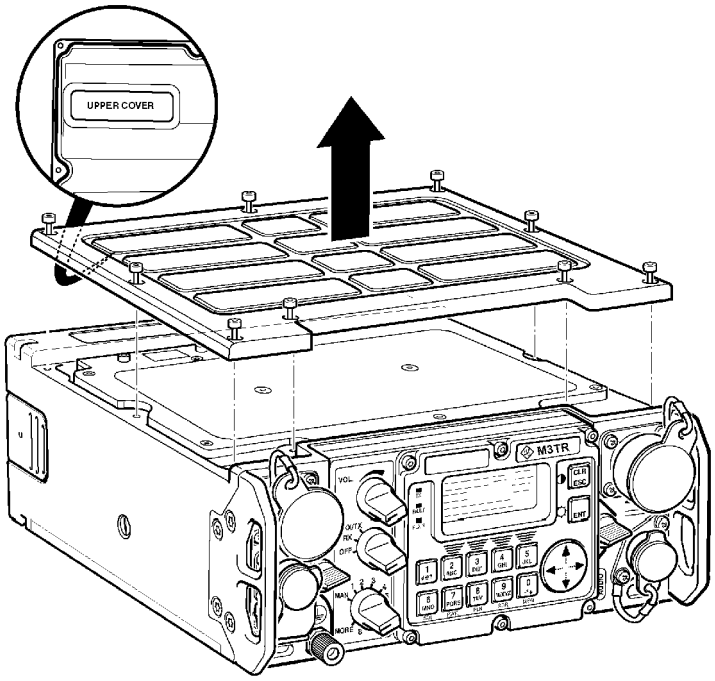
b. Remove the lower cover.

⚠ CAUTION

Turn the cover upside down before putting it on the work table.

The RF gasket on the cover must not get in contact with paper, as the sulphur in the paper will damage the gasket.

Figure 5.19 Removing the Lower Cover



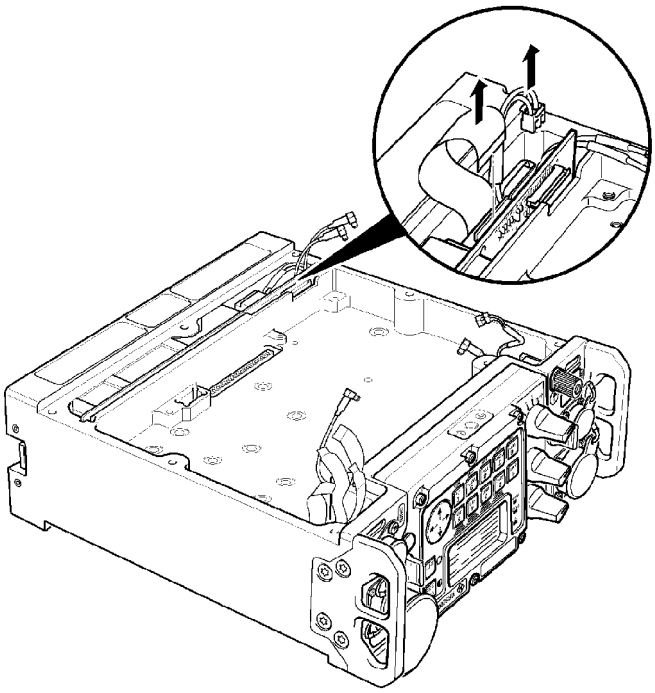
ICN-4G-A-231000-R-D0894-20004-A-01-1

i. Undo the nine captive hexagon socket head screws at the lower cover by using a socket head screw key (2.5 mm).

ii. Lift the lower cover carefully off.

c. Undo the two ribbon cables on the power supply (Figure 5.20). To do so first of all undo the securing clips at the connectors. Then pull off ribbon cables carefully.

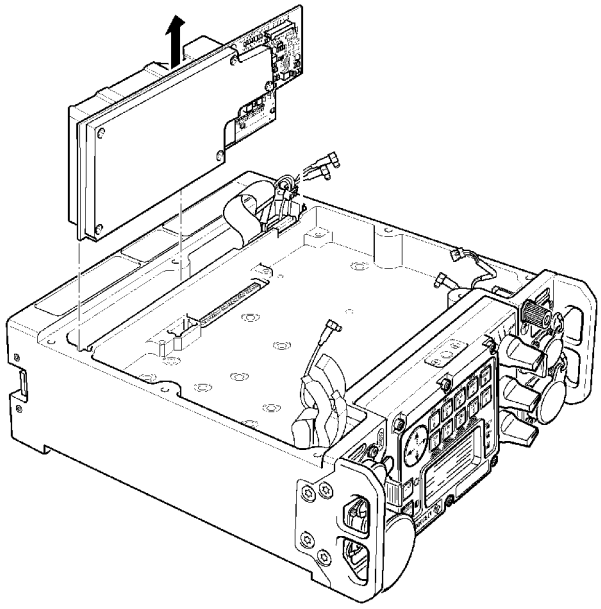
Figure 5.20 Power Supply, Undoing Cables



ICN-4G-A-231000-R-D0894-10013-A-01-1

d. Lift the power supply carefully out (Figure 5.21).

Figure 5.21 Power Supply, Removal



ICN-4G-A-231000-R-D0894-10014-A-01-1

2 Installing the Power Supply:

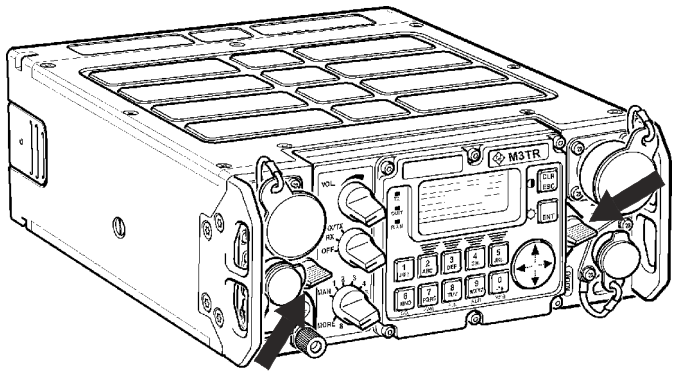
To install a new or repaired power supply proceed in the reverse order of removal.

5.2.7 Front Panel - Change

1. Removing the Front Panel:

a. Turn the two quick-release fasteners on the front panel by 90 degrees to the left (Figure 5.22).

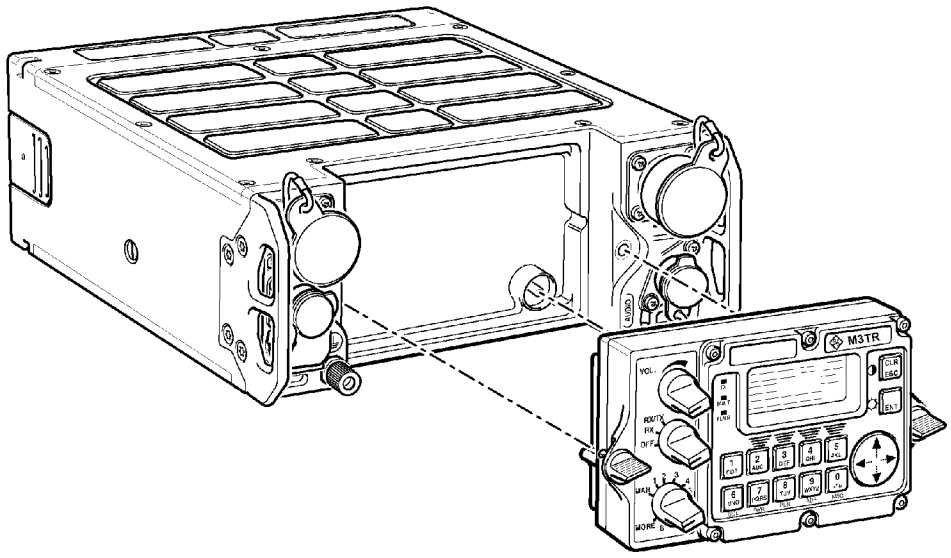
Figure 5.22 Front Panel, Undoing Quick-Release Fasteners



ICN-4G-A-231000-R-D0894-10011-A-01-1

b. Take the front panel carefully off to the front (Figure 5.23).

Figure 5.23 R&S MR 3000U Front Panel, Removal



ICN-4G-A-231000-R-D0894-10012-A-01-1

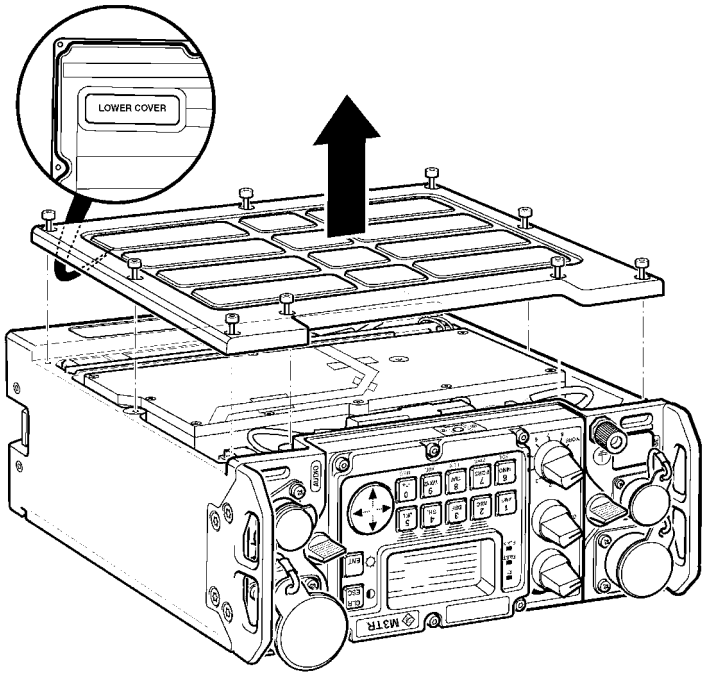
2 Installing the Front Panel:

When installing a new or repaired front panel make sure that the two quick-release fasteners engage correctly in the housing. Only then turn them by 90 degrees to the right to ensure that the front panel is tightly seated.

5.2.8 Radio Controller - Battery - Change

1. Put the tactical radio upside down on a work table so that the lower cover is accessible from the top sect. 5 Replacement of Modules,

Figure 5.24 Removing the Lower Cover

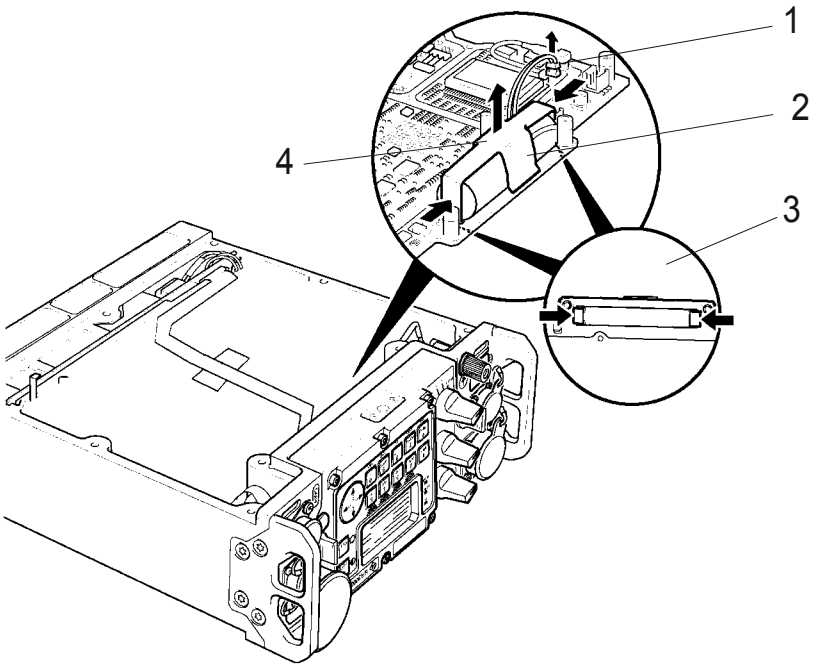


ICN-4G-A-231000-R-D0894-20005-A-01-1

2 Remove the lower cover sect. 5 Replacement of Modules.

3 Undo the battery connector (1).

Figure 5.25 Replacing the Backup Battery



ICN-4G-A-231000-R-D0894-10004-A-01-1

1 battery connector
2 battery holder
3 battery holder (clamp)
4 pull up the battery holder

NOTICE

Mod. 02/03 is illustrated.

Using the new Radio Controller (6126.4877.02) the Backup Battery is fixed with 3 cable tie fastener. Top edge of cover must not protrude!

4 Press the battery holder (2) together on both sides (3) simultaneously and pull the battery with battery holder off to the top (4).

5 To install a new backup battery into the radio controller proceed in the reverse order of removal.

NOTICE

When installing a battery make sure that the battery cables do not get caught anywhere.

It is recommended to replace the backup battery of the radio controller at regular intervals (after five years at the latest).

5.2.9 Housing - Sealing Cords - Change

1.

NOTICE

Replacing the sealing cords of the tactical radio will only be necessary if leakage was found in the immersion test (sect. 4.4 Leak Test).

2 Open the tactical radio (sect. 5 Replacement of Modules).

3 Remove the sealing cords from both covers.

4 Insert the new sealing cords (part no. 6094.9357.00) into the grooves in the covers.

5 Close the tactical radio (sect. 5.3 Assemble Procedures).

6 Repeat the pressure drop measurement and immersion test (sect. 4.4 Leak Test).

5.3 Assemble Procedures

1. Assemble the tactical radio in the reverse order of the disassembling sect. 5 Replacement of Modules.

6 System/Equipment Configuration

6.1 Load Software Procedures

6.1.1 General

With Remote-controlled Transceiver of R&S M3TR all system/equipment configuration is factory-set by way of software and compliance with the customer's specifications. Such settings can be altered by SW Service Procedures - a complete SW-Update can also be performed.

This chapter describes typical software loading into the R&S M3TR (Software Update). For all operations a standard PC is used. Typical Microsoft Windows operations are not explained specifically.

6.1.2 Requisitions

The necessary download software can be obtained on two ways.

1. For each delivered unit a certificate with information about HW- and SW configuration is enclosed. Additionally a CDROM is included with a software update.
2. With the aid of data base POP at Rohde & Schwarz Messgeräte GmbH in Memmingen the belonging partnumber of the update software can be achieved on the basis of the unit's partnumber (Sachnr.) and of the unit's serialnumber. Then the update software can be down loaded from PDM.

6.1.2.1 Equipment specific SW/FW/HW

Firmware Loading Equipment, Service Kit 5200.6977.00
loading via the rear interface:

- Cable for Ethernet (PM 503964-xxx)
- PC (host computer) with serial interface (COM 1 / 2)
- Operating System Windows 2000
- Driver-SW WIN PCAP_3.0.exe
- Power supply 24 VDC (for unit)
- SOFTWARE: UPDATE 32

loading via the docking station ethernet interface at the unit frontside:

- Cable (6125.9200.02)
- PC (host computer) with serial interface (COM 1 / 2)
- Operating System Windows 2000
- Driver-SW WIN PCAP_3.0.exe
- Power supply 24 VDC (for unit)
- SOFTWARE: UPDATE 32

loading via the serial interface (DATA) at the unit frontside:

- Cable R&S GK3003 (6099.8507.02)
- PC (host computer) with serial interface (COM 1 / 2)
- Operating System Windows 2000
- Driver-SW WIN PCAP_3.0.exe
- Power supply 24 VDC (for unit)
- SOFTWARE: UPDATE 32

CNR Operating System Loading Equipment
The same as for FW loading, ”Firmware Loading Equipment, Service Kit 5200.6977.00” on p. 6.2: Firmware Loading Equipment, Service Kit 5200.6977.00.

SECOM H, SECOM V Loading Equipment Radio Configuration

- PC (host computer) with USB interface
- Fill gun R&S R&S R&S GP3000 (6099.3805.02)
- USB driver for fill gun GP 3000/3100
- USB adapter cable (Fill gun - PC; load cable 6118.1750.02 and readout cable 6118.1750.03)
- Power supply 24 VDC

6.1.2.2 Optional Firmware Loading Equipment

- Ethernet Hub
- PC cable (Ethernet Hub - PC)
- Fill gun R&S R&S GP3000 (6099.3805.02)
- USB adapter cables (Fill gun - PC; load cable 6118.1750.02 and readout cable 6118.1750.03

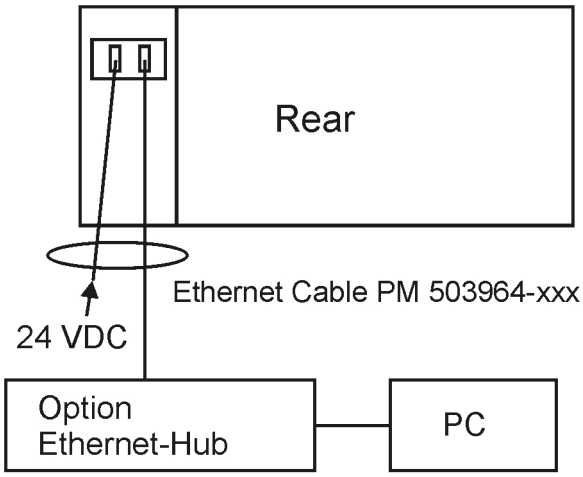
6.1.3 Loading and Update Procedures

6.1.3.1 Hardware Configuration Setup

For software download to the R&S M3TR there is no difference of the hardware configuration setup between loading Firmware, CNR Operating System or Security Code V850.

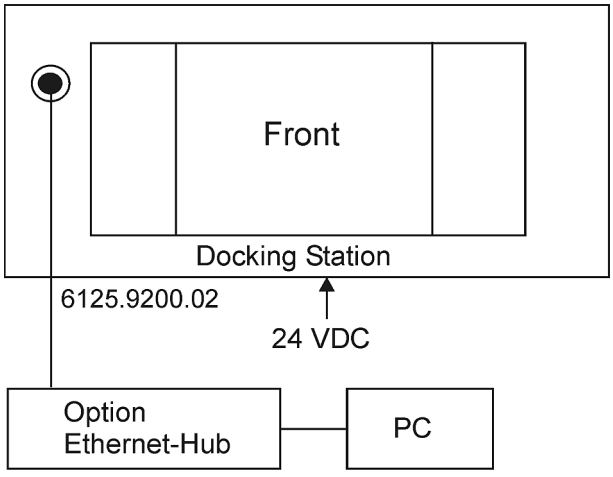
Set up the required hardware configurationFigure 6.1Figure 6.2Figure 6.3

Figure 6.1 Loading without Docking Station



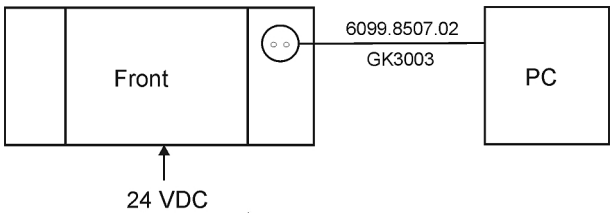
ICN-4G-A-231000-R-D0894-20011-A-01-1

Figure 6.2 Loading Configuration via the Docking Station Ethernet Interface at the Unit Frontside



ICN-4G-A-231000-R-D0894-20012-A-01-1

Figure 6.3 Loading Configuration via the Serial Interface (DATA) at the Unit Frontside (not recommended)



ICN-4G-A-231000-R-D0894-20013-A-01-1

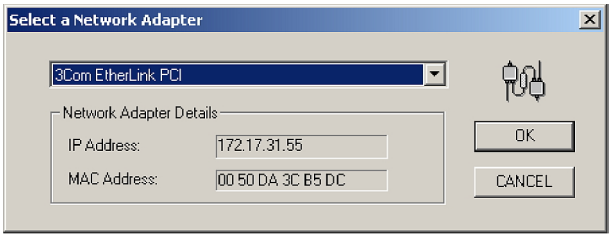
6.1.3.2 Software Download

Firmware Download via the Rear Interface and via Ethernet-Interface of the Docking Station at the Front
For both procedures the loading process is absolutely the same.

Performing:

1. Switch off the tactical radio
2. Switch on the PC (host computer)
3. Start Update32
4. Open Config-Menü
5. Select Network Adapter with shortcut F6 and confirm with the button OK. The following dialog box (Select a Network Adapter) comes up (choose a network adapter, if possibly more are available) Figure 6.4

Figure 6.4 Select a network adapter



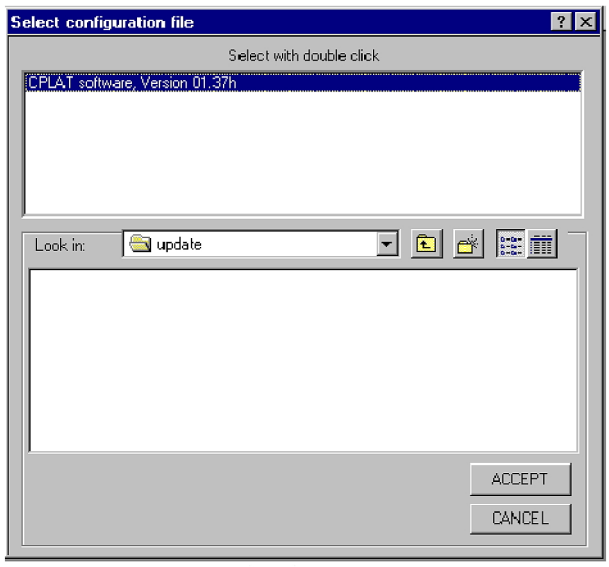
ICN-4G-A-231000-R-D0894-20014-A-01-1

6. Open File-Menu
7. Select Config File with shortcut F2

   - alternatively open it with button "Open File"
8. Select configuration file from the following dialog box:

   - Selection from the menu: e. g. firmware R&S MR300xH Figure 6.5

Figure 6.5 Select configuration file



ICN-4G-A-231000-R-D0894-20015-A-01-1

9. Confirm with button Accept
10. Open Update-Menu:

    - via Ethernet press shortcut F4

    - alternatively press Ethernet-Button

    - press ERASE-Button (red)

11. Switch on R&S MR300xH

    - press ERASE-Button (red)

12. On PC-Display operation:

    - click on the indicated line

    - click on Start-Button

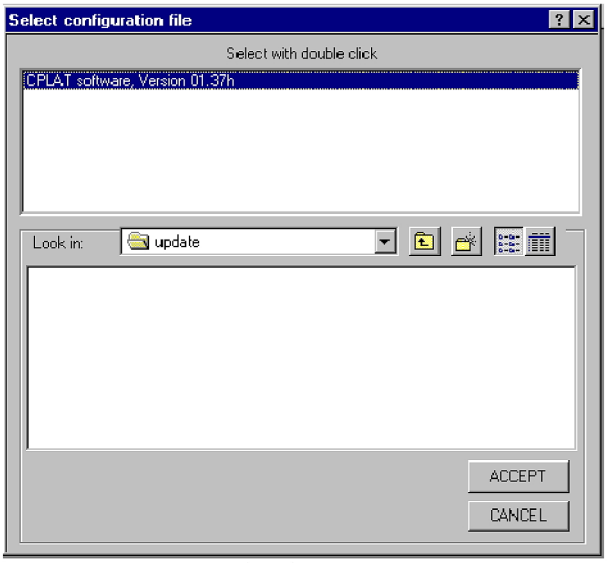
    a. indication START
    b. Update starts
    c. indication ENDE

13. Update finishes
14. Disassemble the setup

Firmware Download via the Serial Interface (DATA) at the Front
Performing:

1. Switch off the R&S R MR300xH
2. Switch on the PC (host computer)
3. Start Update32
4. Open Config-Menü
5. Select Com Port with shortcut F5
   - Select interface COM 1 or COM 2
   - Select speed 115 kBit
6. Select Config File with shortcut F2
   - alternatively open it with button "Open File"
7. Select configuration file from the following dialog box:
   - Selection from the menu: e. g. firmware R&S MR300xH

Figure 6.6 Select configuration file



ICN-4G-A-231000-R-D0894-20015-A-01-1

8. Confirm with button Accept
9. Open Update-Menu via COM with shortcut F3
10. Switch on R&S MR300xH
11. Update starts

12. Indication ENDE
13. Update finishes
14. Disassemble the setup

CNR Operating System Download
With one exception ”Firmware Download via the Rear Interface and via Ethernet-Interface of the Docking Station at the Front” on p. 6.5 the CNR-Operating System upload has to be performed as it is described in section ”Firmware Download via the Serial Interface (DATA) at the Front” on p. 6.8 Software Download.

- download like Firmware,
- the only difference on the PC menu selection:

  NOT firmware R&S MR300xH

  BUT cnr R&S MR300xV wählen

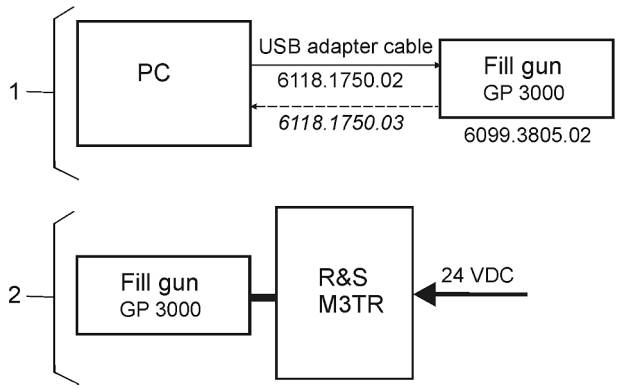
SECOM H, SECOM V Configuration
The SECOM H respectively SECOM V configuration for the R&S M3TR will be performed via the fill gun R&S GP3000 (6098.3805.02). Therefore 2 steps are necessary:

1. Use the USB adapter cable for filler connector (6118.3805.02) and connect the fill gun with the PC to transfer the SECOM data from the PC to the fill gun (1, Fig. A.4).
2. Then connect the fill gun directly with the R&S M3TR to transfer the SECOM data to the R&S M3TR Figure 6.7.

NOTICE

For readout data from the fill gun into the PC use the USB adapter cable 6118.3805.03.

Figure 6.7 Loading Configuration for SECOM H, SECOM V



ICN-4G-A-231000-R-D0894-20016-A-01-1

6.2 Calibration

To maintain the specification of the tactical radio, the oscillator (part of the module Radio Frequency Unit RFU) needs to be calibrated. The time interval for calibration of the reference oscillator is once every five years (together with battery exchange, to be performed by qualified personnel only).

The procedure should be performed at room temperature to ensure correct calibration.

For calibration any possible RX frequency of the radio may be used. Rohde & Schwarz recommends to perform the calibration with a frequency from 10 MHz to 100 MHz. The output power of the frequency standard must in the range of -10 dBm to 0 dBm.

To calibrate the oscillator, the test equipment in the test equipment list (Table 7.2) is required.

NOTICE

Equivalent test equipment may be used.

Special tools are not required.

Table 6.1 List of Test Equipment

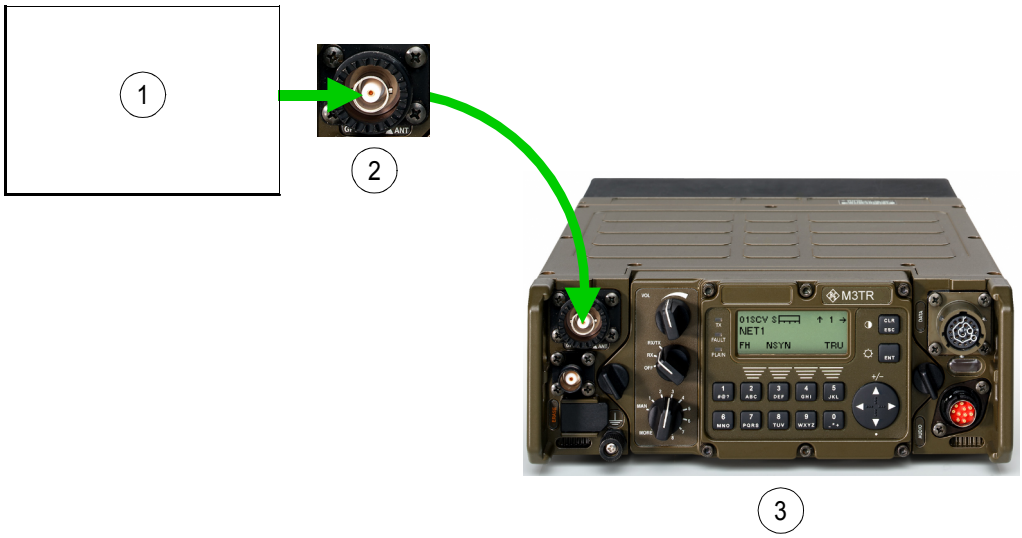
Item	Test equipment, required data	Equipment recommended by Rohde & Schwarz	Ordering code
1	10 MHz frequency standard $\Delta f \leq 0.01$ ppm / -10 dBm to 0 dBm	conventional workshop model	
2	Tactical Radio Operating Documentation		

NOTICE

When using a docking station or an R&S MR 3000H, set the RF input/output port manually to FRONT 50 OHMS!

Do not switch off the radio or disconnect the antenna while calibration is in progress (the process takes 1 to 2 minutes).

Figure 6.8 Test Setup

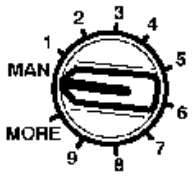
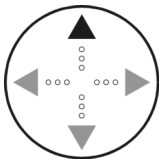
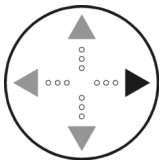
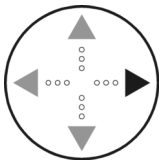
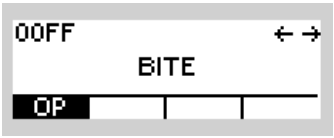
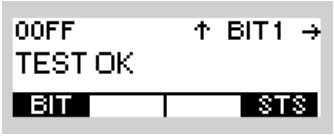


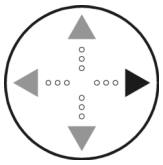
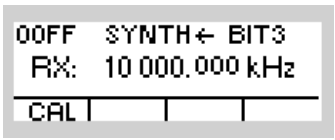
ICN-4G-L-231000-R-D0894-00999-A-01-1

1 Frequency Standard
2 Connector X1
3 Tactical Radio

To calibrate the oscillator proceed as follows:

Step	Control	Action	Note
1		Switch on.	Switch on all test equipment and wait for the clock to stabilize.
2		Connect.	Connect the frequency standard to the antenna connector X1 (see Figure 6.8).
3		Turn the mode switch to RX.	

Step	Control	Action	Note
4		Turn the preset page selector to MAN.	The display changes:
5	2 ABC	Press.	The display changes: Set the RX frequency to the output frequency of the frequency standard (for example 10 MHz, see sect. 3.2.2.1 Changing the Frequency)
6		Press once.	The display changes:
7		Press once.	The display changes: For access to the calibration function it is necessary to enter the code for User Level 2 (see sect. 3.3 Login Operation
8		Press once.	The display changes: 
9	2 ABC (OP)	Press.	The display changes: 

Step	Control	Action	Note
10		Press twice.	The display changes: 
11	2 ABC (CAL)	Press.	
12		Switch off	After the message “FINISHED OK” switch off the tactical radio and disconnect the test setup.

The following error messages may appear during the calibration:

EXT REF LOW LEVEL (external reference low level)

The output power of the frequency standard is too low. Increase the output power or use another frequency standard.

EXT REF WRONG FREQ (external reference wrong frequency)

Calibration with the applied reference frequency failed. Check if the RX frequency set on the radio matches the reference frequency of the frequency standard.

If the frequency set on the radio and the reference frequency are identical (the frequency standard meets the required specifications), the radio hardware may be defective. Please contact the service.

TUNE RANGE FAILURE

Tuning failed because the possible tuning range was exceeded.

If the frequency set on the radio and the reference frequency are identical (the frequency standard meets the required specifications), the radio hardware may be defective. Please contact the service.

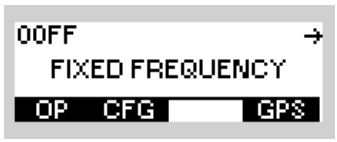
FLASH FAILURE

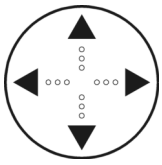
The determined calibration values could not be stored in the FLASH memory. Repeat the calibration procedure. If the error persists, the radio hardware is defective, please contact the service.

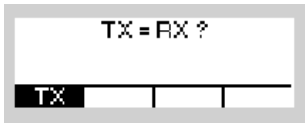
6.2.1 Changing the Frequency

By means of softkey FRQ (Frequency) the operator can change the transmit and/or receive frequency. In RX mode, the effective RX frequency, e.g. 55.250 kHz, is displayed. For PTT, the effective TX frequency, e.g. 55.250 kHz, is displayed (RX frequency = TX frequency).

Starting point: Main page of FF menu

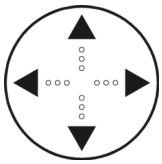


Step	Control	Action	Note
1	2 ABC (OP)	Press.	Open the operational page of Fixed Frequency.
2	0 _*+ to 9 WXYZ	Press any of these keys.	The display changes:
3	2 ABC (FRQ)	Press.	Open the editor window.
4	0 _*+ to 9 WXYZ or 	Enter a new RX frequency. or change RX frequency selectively.	Range: depends on installed option codes Step: 25 kHz

Step	Control	Action	Note
5	ENT	Press.	If the entered RX frequency is within the permitted entry range, the display changes: 

NOTICE

For operation with same Rx and TX frequency, just press enter to finish frequency setting. Continue with 6, if a TX frequency different from the RX frequency is requested.

6	2 ABC (TX)	Press.	Open the editor window
7	0 _*+ to 9 WXYZ or 	Enter a new TX frequency or change TX frequency selectively.	Range: depends on installed option codes Step: 25 kHz
8	ENT	Press.	If the entered TX frequency is within the permitted entry range, the editor window will be closed

6.2.2 Login Operation

- In the LOGIN menu the level of user access (user levels 0 to 2 are available) can be selected, allowing the user to perform the functions he is authorized to use. Selection is made by entering a 4-digit password and confirming with ENT.

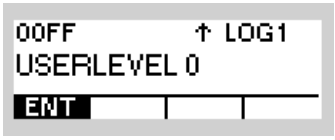
- The following default passwords are defined:

  Level 0: no password required

  Level 1: 1234

  Level 2: 2345

  These passwords can be changed via the R&S RNMS 3000 (Radio Network Management System).
- The issuance of user rights (i.e. user levels) is managed by the system administrator.
- The assignment of user levels to radio functions is fix and cannot be changed. So for instance starting the downloading procedure always requires user level 2 to be selected.

Step	Control	Action	Note
1	2 ABC (OP)	Press.	The display changes, e.g.: 
2	2 ABC (ENT)	Press.	The display changes, e.g.:
3	0 _*+ to 9 WXYZ	Press.	Enter password.
4	ENT	Press.	

7 Spare Parts

NOTICE

The following spare parts are only valid for mod. 04.

The spare parts for other mod. are available on request.

Table 7.1 Spare Parts for R&S MR 3000H

Item-No.	Designation	Component no.	Quantity	Ident no.
10	Protection Gap	-	2	6094.9363.00
20	Cable	W7	1	0048.7070.00
30	Flex-Strip	W6	1	6094.8309.00
40	Cable	W1	1	6094.8721.00
50	Connector	X421	1	6094.7483.00
100	RF Unit	A3	1	6098.9651.03
110	Shielding Corner	-	1	6094.7648.00
125	Front Panel	A4	1	6094.8009.04
130	Retaining Washer	-	1	0031.5104.00
140	Sealing FP	-	1	6094.9340.00
150	Cable	W3	1	6094.7619.00
160	Rubber Keypad	-	1	6094.8044.00
170	Seal Screw	-	1	6099.0635.00
180	FP Control	A41	1	6094.8050.03
190	Keyboard	A42	1	6118.3352.02
200	Keyboard Support 1	-	1	6118.3423.00
210	Keyboard Support 2	-	1	6118.3430.00
220	Keyboard Support 3	-	1	6118.3446.00
230	DIN 912M3X10_A4 HINTE	-	3	6098.9016.00
240	DIN 137 A3-A2 Black	-	5	6098.9045.00
255	Retainer	-	1	6140.7057.00
265	Pressure Spring	-	1	6140.6621.00
270	1/4 Turn Lock	-	1	6126.4148.00
280	Knob	-	1	6126.4248.00
320	Drive Cord		25	0015.2085.00
330	PowerAmpl. HF/VHF	A2	1	6099.0893.02

Item-No.	Designation	Component no.	Quantity	Ident no.
331	Amplifier Board HF/VHF	A21	1	6099.0906.02
332	Harmonic Filter	A22	1	6099.2009.02
333	Hybrid Ampl. HF/VHF	A23	1	6118.3200.02
334	Isolation Foil		1	6099.2209.00
340	ATU 4	A10	1	6126.3341.02
350	Coilboard	A102	1	6126.3535.02
360	Capacitor Board	A101	1	6126.3441.02
385	Cover Sealing		2	6126.5380.00
395	Rubber Strip		1	6140.6780.00
405	Cover		2	6140.6644.02
410	Housing	A9	1	6099.0658.03
430	Protective Cap		1	6094.9370.00
440	M2.5X3 DIN7985 CR BL		1	6086.0325.00
450	Ground Bolt	X3	1	6094.8780.00
460	Nut for Gound Bolt		1	6094.8815.00
470	Cable	W2	1	6094.7602.00
480	Cable	W4	1	6094.7625.00
490	Sealing Ring		1	0071.8227.00
500	Erase Switch w. Cable	S1	1	6099.3205.00
510	Handle PTD		1	6099.1454.02
520	Screw		1	6121.9606.00
530	Audio Connector+FLEX	X4	1	6099.0641.02
545	Data Connector+FLEX	X5	1	6126.5350.02
550	DIN 965/ISR-M4X6-A4-BL		1	6098.9039.00
560	DIN7985-M3X6-A4 Black		1	6098.9022.00
570	Special Receptacle	X6	1	6118.3581.00
580	DIN7985 M3X8-A4 Black		2	6099.3470.00
590	Power Supply II	A5	1	6126.4525.02
600	Radio Controller	A1	1	on request
610	Cabletie	G1.2	1	0099.2181.00
620	Battery with Connector	G1	1	6126.5138.00
710	HCM-3702-01 MANPACK		1	6086.3818.02
720	DSP Extension Board		1	6126.4919.02
730	Warranty Seal		1	6110.5304.00
998	Aerospace Marker		1	3584.7334.00

Table 7.2 Spare Parts for R&S MR 3000U

Item-No.	Designation	Component no.	Quantity	Ident no.
10	Protection Gap	-	2	6094.9363.00
20	Cable	W7	1	0048.7070.00
30	Flex-Strip	W6	1	6094.8309.00
40	Cable	W1	1	6096.1347.00
50	Connector	X421	1	6094.7483.00
100	RF-Unit	A3	1	6098.9651.03
110	Power Ampl. V/UHF	A2	1	6096.1101.03
120	Amplifier Mainboard	A21	1	6096.1253.02
130	Hybrid Ampl. V/UHF	A22	1	6099.0806.02
140	Shielding Corner	-	1	6094.7648.00
155	Front Panel	A4	1	6094.8009.04
160	Retaining Washer	-	1	0031.5104.00
170	Sealing FP	-	1	6094.9340.00
180	Cable	W3	1	6094.7619.00
190	Rubber Keypad	-	1	6094.8044.00
200	Seal Screw	-	1	6099.0635.00
210	FP-Control	A41	1	6094.8050.03
220	Keyboard	A42	1	6118.3352.02
230	Keyboard Support 1	-	1	6118.3423.00
240	Keyboard Support 2	-	1	6118.3430.00
250	Keyboard Support 3	-	1	6118.3446.00
260	DIN912-M3x10-A4 Hinte	-	3	6098.9016.00
270	DIN137-A3-A2 Black	-	5	6098.9045.00
285	Retainer	-	1	6140.7057.00
295	Pressure Spring	-	1	6140.6621.00
300	1/4 Turn Lock	-	1	6126.4148.00
310	Knob	-	1	6126.4248.00
335	Cover Sealing	-	2	6126.5380.00
345	Rubber Strip	-	1	6140.6780.00
355	Cover	-	2	6140.6644.02
360	Housing	A9	1	6099.0658.03
380	Protective Cap	-	1	6094.9370.00
390	M2.5x3 DIN7985 Cr Black	-	1	6086.0325.00
400	Ground Bolt	X3	1	6094.8780.00

Item-No.	Designation	Component no.	Quantity	Ident no.
410	Nut for Ground Bolt	-	1	6094.8815.00
420	Cable	W2	1	6094.7602.00
430	Cable	W4	1	6094.7625.00
440	Sealing Ring	-	1	0071.8227.00
450	Erase Switch w.Cable	S1	1	6099.3205.00
460	Handle PTD	-	1	6099.1454.02
470	Screw	-	1	6121.9606.00
480	Audio Connector+Flex	X4	1	6099.0641.02
495	Data Connector+Flex	X5	1	6126.5350.02
500	DIN 965/ISR-M4x6-A4-Bl	-	1	6098.9039.00
510	DIN 7985-M3x6-A4 Bl	-	1	6098.9022.00
520	Special Receptacle	X6	1	6118.3581.00
530	DIN7985 M3x8-A4 Bl	-	2	6099.3470.00
540	Power Supply II	A5	1	6126.4525.02
550	Radio Controller	A1	1	on request
560	Battery with Connector	G1	1	6126.5138.00
570	Battery with Connector	G1	1	6094.9592.00
580	Battery Holder	-	1	6095.2210.00
590	Cabletie	-	1	0099.2181.00
710	HCM-3702-01 MANPACK		1	6086.3818.02
720	DSP Extension Board	-	1	6126.4919.02
730	Warranty Seal	-	1	6110.5304.00
998	Aerospace Marker	-	1	3584.7334.00

8 Drawings

Basic Assembly

- 6137.9230.01 S

Interface Description for TACTICAL RADIO R&S MR 300xH

- 6118.3000.01 SB

Circuit Diagram for TACTICAL RADIO R&S MR 3000H

- 6118.3000.01 S

Parts List for TACTICAL RADIO R&S MR 3000H

- 6118.3000.01 SA

Interface Description for TACTICAL RADIO R&S MR 300xU

- 6118.3500.01 SB

Circuit Diagram for TACTICAL RADIO R&S MR 3000U

- 6118.3500.01 S

Parts List for TACTICAL RADIO R&S MR 3000U

- 6118.3500.01 SA